SCIENTIFIC AMERICAN SUPPLEMENT. No. 917

Scientific American Supplement, Vol. XXXVI. No. 917.
Scientific American, established 1845.

NEW YORK, JULY 29, 1893.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

THE WORLD'S COLUMBIAN EXPOSITION—THE HORTICULTURAL PALACE.

THE HORTICULTURAL PALACE.

THE *Illustrirte Zeitung* says: "The system followed by the authorities of the Exposition, of showing clearly all the branches of human ability in the most exhaustive manner, gave us reason to expect that horticulture and the departments connected therewith would be properly represented, especially as garden making and the care of gardens has been carried very far in America. In no land, not even excepting Holland, have greater sums of money been expended in this department. The Germans, in whose hands the cultivation of flowers rests for the most part, have known how to accomplish great things. The numerous flower dealers in the large American cities exhibit the greatest wealth of roses, chrysanthemums and carnations, as well as of decorative plants, and the annual flower shows in New York and Chicago and other large cities are first-class social events. The Americans' love of flowers finds excellent expression at the Exposition. Even the building that contains the flowers is well worthy of a visit. The main hall, which is over 328 ft. long, is flanked on both ends by two beautiful pavilions of French renaissance style, and the central portion is surmounted by a great glass dome, which has a span of about 213 ft. and a height of about 180 ft.

Eight extensive greenhouses are connected with this main hall, and there is a great gallery for the pomologic exhibition, in which the beautiful fruits of California, Florida and other States are arranged in towers, pyramids, triumphal arches, etc. Such great apples and pears as those of California and such fine peaches and apricots as those of Delaware and Maryland are seldom seen in Europe; and as far as the oranges of Florida are concerned, these, thanks to the care of the planters, have far surpassed the Italian oranges in size and flavor. The Indian River oranges from the south of Florida are considered the best in the London market. The ornamental plants exhibited in the main hall demonstrate the immense size of the North American continent and the great variety of its products. There are plants here from all climates and of all kinds, from the rare pines and mosses of the far North to the immense date and cocoa palms, and close to the cacti and agaves of the former Spanish territories are beautiful specimens of the immense plants of Mexico, the West Indies and Central America. But still more interesting than these are the charming orchids from Venezuela, plants which have a delicacy of coloring, a beauty and singularity of form and a variety such as are seldom found in Europe. In passing through these groups of palms, orchid beds and this wealth of lianas, I feel as if I had been transported to the tropical forests of the northern part of South America. When beating a path through its thicket for days I scarcely thought it possible that I would find these rare plants again in the North, on the shore of the rough Lake Michigan.

But the most beautiful part of the Horticultural Exposition is the great glass rotunda bordered by its gallery, which is 65 feet high. Up there, cafes and restaurants invite the visitor in, and here he can best feast his eyes upon the tropical beauty. In the center of this great round space an artificial mountain has been built, on the top of which crystal water bubbles up among moss and ferns in the shade of palms of all kinds. Below bloom delicate orchids, rare flowers of the greatest gorgeousness that have never been seen before bathe themselves there in the water; on the skillfully arranged ledges nestle agaves with their high flower stems, the tops of which reach to the crowns of the slender, noble palms. This rotunda of the Horticultural Palace is one of the most charming spots of the Exposition and attracts the better class of Americans. If one wishes to avoid the warm, smoke-laden atmosphere, a little doorway of rock invites him in. It leads to a beautiful grotto which comprises the entire interior of the artificial mountain. Walls, ceiling and floor are covered with shining crystals and oddly-shaped stalactites, taken from that great "Crystal Cave" which was discovered a few years ago in South Dakota, and which in point of size and subterranean beauty rivals the renowned "Mammoth Cave" of Kentucky. Our illustration is from a drawing by C. Limmer, special artist to *Illustrirte Zeitung*.

MINING AT THE WORLD'S COLUMBIAN EXPOSITION.

THAT the Mines and Mining building, also the exhibits contained in it, are in a better condition and nearer completion than those in any other department is largely due, says the *Engineering and Mining Journal*, to the energy and ability of Mr. F. J. V. Skiff, chief of the department, who has done a great deal of hard work himself, and has also understood how to collect and organize a capable staff of assistants. Mr. Skiff has had an extended experience in mining, and has been, therefore, familiar with the needs of his department. At the time of his appointment he was a resident of Colorado.

THE STATE EXHIBITS.

Arizona.—The exhibit of this Territory consists of cabinet collections of specimens, particularly from the copper regions. The Copper Queen Consolidated Mining Company has contributed fairly from its great mine. The trophy in the center of the space is a huge square block of beautiful azurite, from one of Arizona's mines, and is surrounded by a base of malachite, forming a pleasing contrast in blue and green. In the cabinets can be found every combination of carbonates, oxides and native copper, together with beautiful silver incrustations. The petrified wood exhibit from this Territory is exceptionally fine. The Drake Manufacturing Company manufacture this wood into ornamental forms, and have a display here. A number of relics of mining instruments, such as stone axes and gads, found in the Territory, will be placed on exhibition. This exhibit is in charge of Mr. T. R. Sorin, who represents the Territorial Board, of which Mr. S. Price Behan, of Prescott, is vice-president.

California.—The collective display of this State is entered through a handsome triumphal arch, faced with marble of different varieties from the quarries of the State. A very fine collection of minerals has been secured through the efforts of Commissioner McMurray and his able assistant, Mr. William Irelan, the State mineralogist. The Forty-niners' Association have loaned for exhibition an extensive historical collection of relics of the early days in California. The southern counties of the State have formed a society called the California World's Fair Association, the efforts of which in securing interesting exhibits have been very successfully conducted by Mr. Frank Wiggins, of Los Angeles, the secretary.

Colorado.—This State displays in cabinets a great variety of precious metals and gems, metalliferous ores, coal, iron, building stones, clays, salts, mineral waters, oils and metallurgical products. The striking feature of the display is a circle of classic columns of characteristic marble from the various parts of the State. These columns are surmounted by huge masses and blocks of ore. A parapet faced with highly polished Colorado onyx has been built as an inclosure. The county displays have been arranged separately in the cabinets surrounding the space. The valuable Breckenridge collection of gold nuggets will also attract considerable attention. A series of models and geological charts are exhibited by the technical mining schools of the State. Mr. S. Ward, superintendent in charge of the collective mining and mineral exhibit, was a United States juror at the last Paris Exposition. He has been ably assisted by Mr. V. C. Heikes, of the Colorado School of Mines.

Connecticut.—This State contributes to the departmental exhibit of building stones a series of cubes of uniform size from all of the principal quarries in the State. Mr. J. H. Vaill, the executive manager and secretary of the board, has had this matter in charge.

Florida.—The space is occupied by a display of samples of the various grades of phosphates mined by the many companies engaged in the industry in that State. This exhibit is shown in bottles and trays. In connection with this are shown a series of fossil remains which have been found embedded in the phosphate deposits. Mr. S. B. Turman has been commissioner in charge.

Idaho.—Gold and silver ores predominate in the excellent cabinet collection filling Idaho's space. The mining companies of that State have been very liberal and prompt in contributing their rarest and most beautiful specimens. Each county is represented by a typical series of minerals. The wonderful resources of the State in mica are fully brought out by sheets 10 × 12 ft., without a flaw, and as thin as tissue paper. Mr. James M. Wells, the executive commissioner of the State Board, has managed this exhibit, being assisted by Mr. Alliene Case, his secretary.

Indiana.—This State has on exhibition its commercial minerals, such as brick, terra cotta, roofing tile, slate, cement, plaster, marble and building stone, limestone, coal, oils, etc. The executive commissioner, Mr. B. F. Havens, of the State Board, has been assisted in gathering this collection by Prof. S. S. Gorby, State Geologist.

Iowa.—This State has built on her space a section of a typical coal mine, the sides of which are lined with the various and characteristic coals of the State. Displays of quarry products, coals, clays, gypsum, etc., are also made. A grotto of spar and stalactites, with a mineral basis, has been built. Commissioner Duncombe has been in charge of the mining exhibit and his superintendent is Mr. T. Meers.

Kansas.—The exhibit of this State is confined to material of economic importance. Two hundred specimens of stone 6 in. square, the ornamental stones being highly polished, form a very complete and interesting collection. The Atchison, Topeka & Santa Fe Railroad has made a special exhibit, illustrating the resources of Kansas in coal. The economic geology of the State has been brought out by Prof. F. W. Williston, of the State University. The different counties are represented by products of clay and such metals as zinc and copper ores. Maps showing the location of all the quarries, coal veins and lead and zinc deposits in the State are also on exhibition in the space.

Kentucky.—This space is ornamented with a turreted arch of cannel coal, while sections of the same material from the different mines are on exhibition within. There has also been arranged a room in exact representation of one of the most famous chambers of the Mammoth Cave. This room is lined with stalactites and crystals, and upon its walls are hung pictures of the striking features to be found within this celebrated cave. A veteran cave guide is in constant attendance to explain to visitors the many wonders of the place. Several trophies showing the position of the different geological horizons of economic importance have been arranged and pyramids of building stone, coal and clays built. There are maps and charts showing the position particularly of the coal fields, and also a huge relief map of the State. Col. M. H. Crump, of Bowling Green, is in charge of this exhibit.

Louisiana.—The exhibit of this State consists chiefly of salt, including a statue representing Lot's wife, about 8 ft. high, and made of rock salt from the New Iberia Mine. There is also a small display of the commercial minerals, such as sulphur, cement, etc. Commissioner John C. Wickliffe has this exhibit in charge.

Maine.—The exhibit of this State consists of a systematic collection of the scientific and economic minerals, filling about twenty cases. The building stone specimens, which have been selected upon the advice and judgment of George P. Merrill, curator of the National Museum, are in small slabs of uniform size. There will also be a small exhibit of the quartz used in manufacturing sand paper and a varied assortment of construction materials. The exhibit is in charge of Mr. Bayley, of Watertown.

Massachusetts.—A scientifically arranged collection of the minerals of the State is shown in the technical mineral display of the Mining Department. The display illustrates mineralogy and petrography. Mr. E. C. Hovey, of Boston, is the executive commissioner and secretary of the State Board. The details of the collection and arrangement of the minerals were in the hands of Mr. George D. Ladd, of Melrose Highlands.

Michigan.—This exhibit occupies a prominent position in the Mining building, being located on the central court. An entrance of red sandstone from the Upper Peninsula has been erected in the shape of an arch, together with a parapet inclosure of the same material. The great copper companies of the Lake Superior region have responded liberally to the call of the State Board for exhibits of copper and show a great variety, from huge masses of ore and native copper to collections of crystallized copper in curious and interesting forms. Four obelisks of pure copper, ranging in weight from 50 to 500 lb., and also a quantity of wire and sheet copper, drawn and rolled from the native metal, are on exhibition. A model of the Calumet and Hecla mines, belonging to the Museum of the University of Michigan, is also placed on exhibition, and a number of other valuable models constructed especially for this exhibit. There is also shown a collection of copper alloys. Mr. Hubbel, one of the directors of the Calumet & Hecla Co., has been very energetic in furthering the interests of the copper exhibit. Salt, in which Michigan ranks first as a producer, is represented by an excellent and select display. There is also a fair display of ores, iron and copper. Gypsum, coal and building stone form the principal parts of the exhibit of materials from the Lower Peninsula. An interesting model of a regular sized apparatus illustrates the methods of transporting ores from the mines to the stamping mills, and the appliances for washing, stamping and separating the ores. Mr. Peter White, of Marquette, is in charge of the general exhibit, being assisted by Mr. Samuel Brady, who is superintendent of the installation.

Montana.—This State has a scientific display of the ores of the precious and base metals. This collection has been carefully prepared under the supervision of scientific men, and has been drawn from the producing mines of the State. In addition to the ores, there is a considerable and attractive collection of the bullion and other products of the mines and furnaces. A collection of marble and building stones, coal and fire brick, clays and coke is also on exhibition. The striking feature of the exhibit is the silver statue of Justice, in heroic size. The silver bullion in this statue is valued at \$32,000, and it rests upon a solid gold plinth valued at \$300,000. A trophy of sapphires and other precious gems gives an idea of the extent and variety of the resources of this State. There are two glass models on exhibition showing underground workings and illustrating mining engineering. There are over 2,000 exhibitors in the collective exhibit of the State. The exhibit is in charge of Mr. William Bickford, executive commissioner, and Prof. F. W. Traphagen, of the Montana College, of Deer Lodge.

Minnesota.—The resources of the iron mines and the numerous quarries of the State have been drawn upon to furnish the display. A collection of mineral specimens has also been arranged for exhibition. The space is surrounded by a facade built of the quarry products of the State. The variety of the color and texture of the stone makes a pleasing appearance. Upon each stone in the arch of this facade will be printed in gilt letters the name of the quarry from which it is produced. Working models of mining plants and accessories have been placed on exhibition, and a number of trophies and ores are attractively disposed about the space. Books, maps, charts, etc., illustrative of mining engineering, are also included in the exhibit. Mr. H. B. Moore, commissioner of the State, and Mr. D. H. Bacon have charge of the display.

Missouri.—This State has provided an attractive pavilion, constructed of native terra cotta. Within the area thus formed is to be found a very interesting technical display of the lead and zinc ores. Products are shown illustrating metallurgy and the preparation of building stones and clays, together with a varied assortment of the minerals of the State in all stages, ranging from crude to finished material. There is an exhaustive cabinet presentation in lithology, crystallography and geology. A number of topographical models and geological sections of the State are shown; also models of reduction works as operated throughout the State. There are also a number of exhibits illustrating the work of the Geological Survey. Mr. J. K. Gwynn, executive commissioner of the State, with the assistance of Prof. Winslow, State Geologist, has had direct charge of the exhibit. Mr. E. O. Hovey has superintended the placing of the mineral display.

Nevada.—This State will be represented by a number of collections of minerals, particularly of gold and silver ores, many of which are worth thousands of dollars. The collection will comprise over 5,000 specimens. The exhibit is in charge of J. A. Yerrington, chairman of the State commission.

New Jersey.—The exhibit of this State has been secured and arranged through the instrumentality of the State Geologist, Prof. J. C. Smock. It comprises an exhibit of minerals of economic importance, such as potter's clay, sands, etc. The work of the Geological Survey is fully represented by systematic collections of rocks, ores and minerals, as well as by maps, charts and other publications. Prof. Nason has been placed in actual charge of the State exhibit in the Mining building.

New Hampshire.—The building stones of the State are liberally represented in the departmental collection by cubes of uniform size from the various quarries. The mica industry is also presented in its various phases. Mr. E. N. Shaw, executive commissioner, has arranged the details of the exhibit.

New Mexico.—The mineral exhibit from this Territory is one of the finest of the Exposition. It comprises many private collections of a varied assortment of minerals, as well as many extensive and rare county collections. The central feature of the display is a miner's cabin, covered with crystalline minerals of great variety. This cabin was erected by the Sierra County Association. A relief map of the Territory is also included in the exhibit of that Territory. The Atchison, Topeka & Santa Fe Railroad Company has assisted in making an interesting coal exhibit. The exhibit is in charge of Mr. T. B. Mills, executive commissioner, and W. H. H. Llewellyn, secretary of the Territorial Commission. Professor J. C. Carrera is superintendent of the mineral exhibit.

New York.—A handsome building, designed by a leading New York architect, fronts the space assigned to that State. At the entrance a geological pyramid has been erected, showing the formations of the State from the old Laurentian system to the base of the coal measures. A great variety of valuable stones and ores is exhibited in this inclosure. The famous salt works of the State have an interesting exhibit of their products. Mr. Fred J. H. Merrill, secretary of the State Museum, at Albany, is in charge of the exhibit, his assistant on the grounds being Mr. H. Ries.

North Carolina.—The State has erected a pavilion

of mica, within which are shown, under glass, the many variety of gems and gem stones, gold nuggets, and precious metals found in the State. Of the ores and metals, copper, lead, zinc, iron, etc., as well as coal, of from 500 to 600 varieties are shown. The corundum and abrasive exhibit is very fine. The exhibit of gems includes rubies, sapphires, ornamental emeralds and topaz, garnets, amethysts, quartzes of different colors, spinels and beryls of all shades. The display has been prepared under the direction of the State Board and Mr. T. K. Bruner, commissioner of exhibits for the State.

Ohio.—This pavilion is entirely of building and ornamental stone and fancy brick, and presents a most solid and imposing appearance. The exhibit of the State is principally of the industrial and economic minerals, especially of clays and coal. A cube exhibit of sandstone has been prepared, and the United Salt Company will demonstrate the methods of preparing salt for the market. The executive commissioner, D. J. Ryan, aided by Mr. Haseltine, chief inspector of mines for the State, has prepared and arranged the exhibit.

Oregon.—A representative mineral exhibit is shown in cabinets within a pavilion of artistic design. The many new quarries of ornamental stone, such as serpentine, have the qualities of their product represented. Mr. C. Clarence Ayers is in charge of the display.

Pennsylvania.—This State makes probably the most complete and scientific mineral display of all. Nearly every group in the classification of the department is amply represented by samples from the mines and quarries of this State. The mineral collections comprise thousands of specimens. There is a full series of samples of anthracite and bituminous coals, with analysis in each case. The artificial mineral products of the State, as well as building stones, clays, sands, graphites, asbestos, mica, and sandstone, are represented, as are also the varieties of practices in making charcoal and coke, and the various processes of treating pig iron, and a display representing the manufacture of zinc oxides. Improvements in mining machinery are brought out by means of models. The Geological Survey has a full set of its publications and maps on exhibit. The State has spared no expense in the matter of installation and preparation. A special feature is arranged for in the shape of a pyramid of anthracite coal, 62 ft. high, representing the width of the greatest anthracite coal seam in the State. Mr. A. B. Farquhar, executive commissioner of the State Board, and Professor Louis E. Reber, of the State College, have supervised the work of collection and arrangement, being assisted by Professor Romeyn Hitchcock, formerly of the United States Museum.

South Carolina.—Phosphate mining, the principal industry of this State, is represented by an interesting display of the phosphates, shown in glass jars. The products thus exhibited will include both the crude and the prepared article, and in connection with the exhibit will be shown a number of the fossils found *in situ*. A pyramid of phosphate adorns the center of this space. The exhibit has been secured and arranged through the efforts of Mr. E. L. Roche, of Charleston, National Commissioner.

South Dakota.—The Black Hills region furnishes the main body of the mineral display for South Dakota. It comprises a great variety of gold, silver, and tin specimens. The State School of Mines has furnished a number of scientifically arranged collections. The exhibit of this State is within a handsome and classic inclosure. Mr. Thomas H. Brown, secretary of the South Dakota World's Fair Commission, is in charge of this exhibit.

Tennessee.—The display of this State consisting largely of building and ornamental stones, marbles, etc., coal and other commercial products, has been made very interesting and complete. Mr. L. W. Rockwell is the secretary of the board in charge of the exhibit. The building stones have been shown in the form of a pyramid, erected in the center of this space, while the front is adorned with panels of marble, terra cotta, etc.

Utah.—The mineral exhibit is exceptionally fine, all of the prominent mines having contributed specimens to the collections, which include gold, silver, lead, copper, zinc, antimony, bismuth, tellurium, and quicksilver ores. There is also a display of the commercial minerals, such as selenite, gypsum, salt, coal, asbestos, and slate. The list of gems represented includes topaz, garnets, opals, malachite, onyx, agates, crystal quartz, and wood opals. Mr. Don Maguire is superintendent of the mining exhibit, and its success is attendant, for the most part, on his efforts.

Vermont.—A cube exhibit of the building and ornamental stones of the State is Vermont's contribution to the general display in the Mining building at the Exposition. These specimens are derived from every leading quarry in the State, and are dressed to a size corresponding with that adopted by the United States National Museum, with the different faces finished in different manners, thus showing the various characteristics of the stone to the best advantage. Mr. McIntyre is executive commissioner for the State, and has had charge of all arrangements for the display.

Virginia.—This State has a good exhibit of almost all the minerals and ores of iron, manganese, lead, zinc, barytes, ochers, asbestos, mica, coal, onyx and other marbles, sandstones, soapstones, slate and other building stones. A series of metallurgical samples illustrating the process of reduction is shown. A pyramid of ores will be arranged as a trophy in the central space of the exhibit. Photographs and drawings of the coal and iron mines, and of the most typical apparatus employed in their operation, are exhibited on the walls. Dr. J. S. Apperson, of Richmond, the executive commissioner of the State Board, has been particularly instrumental in gathering and installing this fine State exhibit.

West Virginia.—Coal and coke forms the prominent part of the exhibit, although a large variety of iron ores is also shown. This exhibit, together with several other varieties of commercial products of more or less mineral character, will be disposed in attractive forms about the space, such as in facades, trophies, arches, etc. Mr. W. N. Chancellor, of Parkersburg, president of the State Board, is in charge.

Washington.—In this space is a very attractive collection of gold nuggets, valued at thousands of dollars. Many varieties of gold and silver ores, copper ores, magnetic iron ores, garnets, and of building stone, coals, etc., have a place. A systematic search for handsome and attractive specimens was made by the Board of Managers of this State, and the 150 tons of minerals were collected from every county and mining district. Mr. N. G. Blalock has been ably assisted by Mr. George E. Pfunder in arranging this exhibit.

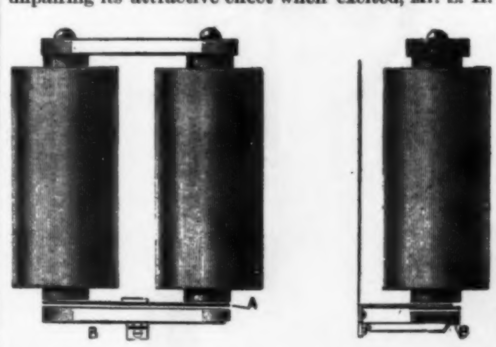
Wisconsin.—The space is situated on Bullion Boulevard, and is marked off by striking monoliths at the four corners. Garnet, lime and sand rocks, iron ores, and especially lead and zinc ores, play a most prominent part in this mineral exhibit. Other special features are gold and silver, quartz, copper, diamonds, jasper and serpentine. The pearl display is exceptionally fine. This exhibit has been assembled through the efforts of Mr. John H. Savage, of Shullsburg, with the co-operation of the executive commissioner, Mr. R. B. Kirkland, of Jefferson, Wis.

Wyoming.—This exhibit consists principally of samples of the precious metals; the exhibit includes, also, specimens of iron ores, building stone, etc., produced in that State. A map of the State, showing the distribution of the minerals geographically, is on exhibition, as well as maps showing underground workings and illustrative of mine engineering. This display has been gathered by the efforts of Mr. Elwood Mead, secretary of the commission, and Mr. L. D. Ricketts, commissioner.

"NON-STICKING" ARMATURE.

As is well known, considerable difficulty and annoyance is experienced in the use of the electro-magnet by reason of the adherence of the armature thereto after the current has been cut off, such adherence being caused by the residual magnetism. Heretofore the effects of this residual magnetism have been destroyed by the interposition of a thin plate of diamagnetic material, as brass, between the poles of the magnet and the armature. This plate is made of such thickness as to hold the armature without the comparatively feeble field of force of the residual magnetism. Although a very thin sheet of diamagnetic material will effect this purpose, the use of such a plate is objectionable, as it will, however thin, appreciably diminish the power of the magnet when excited, the power decreasing generally as the square of the distance of the armature from the poles of the magnet.

With the object of neutralizing the effect of the residual magnetism on the armature without in any way impairing its attractive effect when excited, Mr. S. H.



Stupakoff, of Pittsburg, Pa., has recently devised the arrangement shown in the accompanying engravings. In order to avoid the adherence of the armature after the current has been cut off, by reason of residual magnetism, a strip, A, of iron is interposed between the armature, B, and the poles, so as to extend across from one pole of the magnet to the other. This strip is made of sufficient size to absorb the lines of force of the residual magnetism emanating from the poles of the magnets, but does not constitute a sufficient path for the magnetic lines when the magnets are excited. The strip is supported a short distance away from the poles of the magnet by a resilient tongue attached at its outer end to the frame supporting the magnets, or it may be held in contact with the poles or permanently attached thereto.

When the magnets are excited by the passage of the current, the strip, if held away by a resilient support, will be first attracted to the poles, but as the quantity of metal in the strip is insufficient to serve as a sufficient path for the magnetic lines from one pole of the magnet to the other, the armature will be drawn up against the strip, and as both strip and armature are of magnetic material, they will be practically an integral structure, the armature being held against the strip with nearly the same force as it would be held against the poles themselves. When the current is broken, the strip will act as a sufficient path for the residual magnetism in the cores, and thereby free the armature from all material attractive force.—*New York Electrical Engineer.*

THE NATURE OF DEPOLARIZERS.*

By HENRY E. ARMSTRONG.

WHEN an electric current is passed between plates of platinum through a solution of sulphuric acid, the hydrogen and oxygen are partly retained at the surfaces—and apparently also within the plates—and under these conditions are capable of interacting, as in the well known Grove gas battery; so that in so far as the "gases" thus circumstanced are concerned, the change may be expressed by a reversible equation. This reversal constitutes the well known phenomenon termed polarization by physicists.

Reversal owing to the retention of hydrogen in circuit is promoted to different extents by different metals—hence apparently the varying electromotive forces of single-fluid cells containing different negative plates; and when the pressure is sufficient to retain the whole of the hydrogen at the plate, it becomes total—hence it is, for example, that zinc does not dissolve in sulphuric acid under great pressure.

* Read before the Chemical Society, London.—*Chem. News.*

Various substances known generally as depolarizers are used to prevent the accumulation of products of electrolysis and the consequent reversal of the action—such as copper sulphate in the case of the Daniell cell, and "nitric acid" in the case of the Grove and Bunsen cells; but whereas the action of copper sulphate is easy to understand, that of "nitric acid" offers many difficulties. As the heat of dissolution of copper in dilute sulphuric acid is a negative value (about 12,000 units), the displacement of copper by hydrogen, *i. e.*, the heat of dissolution of hydrogen in copper sulphate, is a positive value, so that not only does the presence of the copper sulphate prevent the accumulation of hydrogen, but in removing hydrogen it also serves to increase the electromotive force of the cell from about [illegible] to about [illegible] of a volt. The principle underlying this is extensible, even to cases in which one part of the cumulative effect of the cycle of change is a negative value. Thus, although copper has a negative heat of dissolution, it will readily dissolve in dilute sulphuric acid if it be used in place of zinc in a Grove cell, the negative heat of dissolution of copper being more than compensated for by the positive heat of dissolution of hydrogen in "nitric acid;" and it is well known that copper dissolves in many weak acids in presence of oxygen. It is easy to understand how oxygen acts in such cases, but the facts show that the effect produced by "nitric acid" is not so readily interpreted, and their consideration raises important questions of general application.

Russell and Lapraik have shown that when "nitric acid" is freed from nitrous compounds it does not dissolve silver, but that action sets in when a trace of nitric oxide is introduced, and continues with increasing rapidity as the quantity of the nitrous compound—a necessary product of the action—increases; Veley's later experiments have shown that the same is true of copper, without, however, affording any further explanation of the phenomena. Although it is not to be expected that such metals would dissolve in nitric acid even when coupled with a relatively electronegative conductor, as they have negative heats of dissolution, yet if the acid also acted as depolarizer a cycle might be formed in which sufficient energy would be developed to condition change; it therefore follows that in such cases nitric acid does not act as the depolarizer in accordance with the equation:

$$2Ag + 2NO_3H + ONO_2H = 2AgNO_3 + H_2O + NO_2H,$$

and that in point of fact the nitrous compound is the depolarizer, although the nitric acid is the actual solvent of the metal, the hydrogen of the acid being virtually directly displaced by the metal with the assistance, however, of the current energy derived from its own oxidation by the nitrous compound.

But what interpretation is to be given of the behavior of more active metals, such as zinc, magnesium, etc., which have positive heats of dissolution, and, therefore, are capable of dissolving in the pure dilute acid if coupled with a relatively negative conductor; does nitric acid in their case directly act as depolarizer? If it be capable of thus acting, such metals even when uncoupled should dissolve in the pure diluted acid. It is noteworthy that when such metals are dissolved in nitric acid, hydrogen is sometimes evolved. It has been suggested that this hydrogen is derived from the interaction of the metal and water, but I cannot now regard this as a probable explanation; its production serves rather to suggest a deficiency of the depolarizing agent, which cannot well occur if nitric acid be the depolarizer. Indeed, if nitric acid be regarded as directly active, it is remarkable that in presence of the large excess of the acid which is always present any hydrogen should escape; and also that the reduction should extend so far as it often does, and not extend merely to the formation of nitrous acid. If, however, the acid be incapable of directly acting as depolarizer, and a nitrous compound be the initially active depolarizing agent, it is no longer surprising that owing to the nitrous compound suffering further reduction it should be deficient in parts of the circuit, and that consequently hydrogen should escape. Why the reduction should extend so much further when metals having positive heats of dissolution are used, however, still requires elucidation.

In the case of sulphuric acid, whatever metals be dissolved in the *diluted* acid, no reduction takes place, and it is only when the concentrated and more or less heated acid is used that sulphurous oxide and other reduction products are obtained. It appears not improbable that reduction only takes place under conditions under which the presence of sulphuric *oxide* is possible, *i. e.*, that depolarization is effected by sulphuric *oxide* and never by sulphuric *acid*, although this latter may be regarded as the actual solvent of the metal. There is at present no evidence forthcoming to show that nitric acid can dissociate into the anhydride and water, and even if such a change took place in concentrated solutions, there is no reason to assume that it can also take place in dilute solutions, and that this is the explanation of the difference between nitric and sulphuric acids. It is well known, however, that nitric acid is resolved with extreme facility into nitrogen dioxide, water and oxygen, and that it is excessively sensitive to the action of nitric oxide—a trace of nitric acid would therefore exercise a fermentative action and condition, the formation, it may be, of nitrous acid, or—as there is no evidence compelling us to suppose that the compound represented by the formula HNO_2 exists—it may be of nitrogen dioxide. In this latter case solutions of nitric acid would resemble concentrated sulphuric acid in containing a reducible oxide, and it may be that their depolarizing action is initially exerted through such an oxide alone.

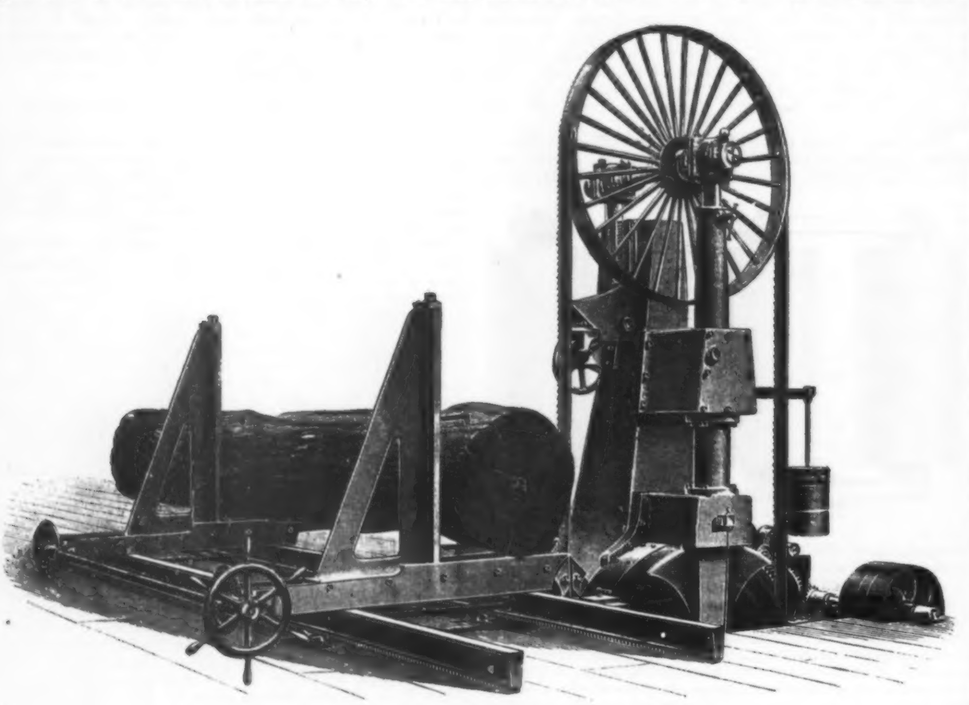
To arrive at a clear conception of the function of acids in dissolving metals, and of the nature of depolarizing agents, it would, therefore, appear to be necessary to take into account many circumstances to which hitherto but little attention has been paid.

ELECTRODES FOR STORAGE BATTERIES.—G. E. Heyl, Berlin, Germany.—The improvement consists in using electrodes composed of compounds of chromium or tungsten mixed with oleic or resinic acid, or with a mixture of these acids, or the chromate or tungstate of lead may be employed and compressed into a compact mass in moulds of the required shape with or

without the addition of a cementing material. When compounds of oleic or resinic acid are employed, the method preferred is as follows: The compound of chromium or tungsten, for instance, chromic acid, is finely ground and brought into a kneading machine, which is heated up to 285° F., and just as much resin or heavy oil as is requisite for complete combination with the chromic acid is added in small quantities. When the mass has been thoroughly kneaded, it is pressed into frames as usual, and electrodes consisting of insoluble resinates or oleates of chromium are the result.

BAND-SAW MACHINE.

IN the machine illustrated, which has been constructed by Messrs. Thomas Robinson & Son, limited, Rochdale, special attention has been directed to the arrangement of the saw pulleys, for it is mainly on their efficiency that the good working of machines of this class depends. The top pulley is of wrought iron, and is carried between two long self-adjusting swivel bearings. The bottom pulley is of cast iron, and considerably heavier than the top one, and is also carried between swivel bearings. The top and bottom outside bearings are connected with a continuous beam which gives them a very rigid support. The arrangement for tightening the saw is extremely sensitive, and allows freedom for expansion and contraction. The carriage which carries the log is constructed entirely of iron, and is provided with screw dogs, which grip the log on the top and bottom sides. The travel of the carriage backward and forward is worked by friction gearing, and the motion can be instantaneously varied to suit the nature of the work.—*Industries.*



IMPROVED BAND SAW MACHINE.

[FROM THE WAYNE COUNTY HERALD, APRIL 27, 1893.]

HORATIO ALLEN'S RIDE.

THE *Herald* has put upon record time and time again the well known historical fact that the first locomotive wheels ever turned upon a track in America were those of the "Stourbridge Lion," over the Delaware and Hudson railroad at this point, on the 9th of August, 1829. As the time for the Fair draws near all sorts of claims are made for this distinction, and the "John Bull," of 1830, is especially being exploited at this writing, as a claimant for the honor.

As a good contribution to the history of this important matter, we give below a corroboration of all that we have heretofore stated, taken from the *Scranton Truth* of Friday last, and which coming from the source it does, ought to be held conclusive. We may say also at this time that Dr. Otis Avery, Hon. John Torrey and Mrs. B. Egelston, all residents of this town to-day, were witnesses of the notable first trip of the "Lion."

The writer hereof and scores of other Honesdale boys have hundreds of times clambered over the odd looking wheels and have pulled the valves and worked the walking beam of this pioneer—not only of America, but of the world. In fact, it used to be great sport for one of us to assume the place of engineer while others took the posts of firemen, brakemen and passengers, and thus to start out upon our journey with sad good-bys to our friends. After much tooting of the engine and great hilarity among our party, we would finally pretend to land at Waymart and there receive the congratulations of our friends upon our safe arrival. Of course, all this in the open shed near the Methodist church, where for many years the old engine with its fearful head of a lion in bold relief on the front of its boiler was housed. In later times thievish vandals unscrewed the nuts, removed the slender rods, and in time carried away everything that could be unloosed. The boiler was finally sold to some person in Carbondale and used until worn out. An offer of the Delaware and Hudson officials to pay scrap iron prices for it was refused, and it was afterward sold to the Smithsonian Institution in Washington, where we believe it still remains. The price paid for it was $300. But here is the interesting story of Horatio Allen, the first locomotive engineer in America:

A short time ago the editor of the *Truth* wrote to the venerable Horatio Allen, the gentleman who ran the first locomotive ever run on a railroad on this continent, for some details of that famous ride which took place on the Delaware and Hudson Company's road, near Honesdale, on the 9th of August, 1829. A courteous reply was received from Mr. Allen yesterday, accompanied by his account of the event. After describing his visit to England in 1828, to order three locomotives for the Delaware and Hudson Co., on the plan of the Stephenson locomotive of 1825, Mr. Allen continues his very interesting narrative as follows:

In the order thus given in the early summer of 1828 for three locomotives is presented the fact that the first order for a locomotive, after the demonstration of the locomotive as a successful tractive power on the Stockton and Darlington Railroad in 1825, came from an American company on the report of their chief engineer, trusted to the discretionary action of an American civil engineer.

The three locomotives were received in New York in the winter of 1828 and 1829. One of each kind was set up, with the wheels not in contact with the ground, and steam being raised, every operation of the locomotive was fully presented, except that of onward motion.

The locomotive from Stourbridge received its name, "Stourbridge Lion," from the fancy of the painter, who, finding on the boiler end a circular surface, slightly convex, of nearly four feet in diameter, painted on it the head of a lion, filling the entire area and in bright colors.

The river and canal being closed by ice, it was not until the opening of navigation in the spring of 1829 that access was had to the railroad at Honesdale, Pa., which is at the head of the canal and at the beginning of the railroad.

Returning to New York during the winter of 1828 and 1829, I refer to a brief connection with the Delaware and Hudson Canal Company, to present in striking contrast the financial resources of that time and the present. The Delaware and Hudson Canal railroad and mining development had been brought so near to completion and productive use, by the expenditure of a stockholder capital, that only $300,000 were required to bring into operation this great enterprise of delivering anthracite coal on the waters of the Hudson River, and by that river at tide water at New York.

But so limited were the financial resources of the time, that it was found necessary to apply to the Legislature of the State of New York for the loan of the credit of the State to raise $800,000. In the application it was found necessary to meet the representations, afterward found to be gross misrepresentations, of those who took great pains to prevent any appropriation of money, private or public, to an enterprise so full of uncertainty. The representation made it necessary to prove that the coal transported would burn. Under these circumstances I was invited to pass a few weeks at Albany, to be of such use as might be. When the time came that one of the locomotives was to be sent by river and canal to Honesdale, the "Stourbridge Lion" was sent.

In reference to future events, so near by, it is to be regretted that one of the Stephenson locomotives was not sent, and for the reason that the locomotives built for the Delaware and Hudson Canal Company by Stephenson were the prototypes of the locomotive "Rocket," whose performance in October of the same year astonished the world.

The two locomotives from Stephenson that were in New York early in the year 1829, and, therefore, prior to the trial of the locomotive "Rocket" in October of that year, were identical in boiler, engines, plan and appurtenances with the "Rocket," and if one of these two engines in hand ready to be sent had been the one used on August 9, the performance of the "Rocket" in England would have been anticipated in this country.

The present time and incidents of the "Stourbridge Lion," the first locomotive run on this continent, I have to continue my personal narrative.

Early in the summer of 1829 I had received the appointment of chief engineer of the South Carolina Railroad, a road to extend from Charleston to the ocean, to a point opposite to Augusta, Ga., on the Savannah river, a road of about 150 miles in length, but I was not to go to Charleston to commence my duties until September. Being thus at liberty in July and August, I volunteered to go to Honesdale and take charge of the transfer of the locomotive from the canal boat to the railroad track, within twenty feet, and about eighteen feet above the level of the canal boat.

The line of road was straight for about 600 feet, being parallel with the canal, then crossing the Lackawaxen creek by a curve nearly a quarter of a circle long, of radius 750 feet, on trestle work about thirty feet above the creek, and from the curve extending in a line nearly straight into the woods of Pennsylvania.

The road was formed of rails of hemlock timber in sections six by twelve inches, supported by caps of timber ten feet from center to center. On the surface of the rail of wood was spiked the railroad iron—a bar of rolled iron two and a quarter inches wide and half an inch thick.

As the locomotive was seen in mid-air in its transference from the canal to the railroad the opportunity was had to see that the axles had an unyielding *parallel* position, there being no king bolt that provided facility for passing round the curve, and that, therefore, the four wheels holding their rigid position were to be forced round the curve by the power of the steam engine. The locomotive thus seen altogether impressed the lookers-on as being of great weight. The road having been built of timber in long lengths, and not well seasoned, some of the rails were not exactly in their true position when the time came that they were to carry the locomotive in its onward movement.

Under these circumstances the feeling of the lookers-on became general that either the road would break down under the weight of the locomotive or, if the curve were reached, that the locomotive would not keep the track, and in its onward motion without support it would dash into the creek with a fall of some thirty feet.

On my part I knew that the road would carry the locomotive safely, and that the curve would be passed without any difficulty. But when the time came, and the steam was of the right pressure, and all was ready, I took my position on the platform of the locomotive alone, and with my hand on the throttle valve handle, said: "If there is any danger in this ride, it is not necessary that the life and limbs of more than one be subjected to that danger; that, having no doubt whatever, I was about to take the ride entirely alone, and that the time would come when I should look back with great interest to the ride that was now before me."

The locomotive, having no train behind it, answered at once to the movement of the hand, and there being no doubt as to the result, a motion was had at once in which there was not any evidence of distrust; soon the straight line was run over, the curve was reached and passed before there was time to think as to its not being passed safely, and soon I was out of sight in the three mile ride alone into the woods of Pennsylvania.

I had never run a locomotive nor any other engine before. I have never run one since; but on the 9th of August, 1829, I ran that locomotive three miles and back to the place of starting, and being without experience or a brakeman, I stopped the locomotive on its return at the place of starting. After losing the cheers of lookers-on the only sound, in addition to that of the exhaust steam, was that of a timber structure when the parts are brought into the bearing state.

Over half a century passed before I again visited the track of this first ride on this continent. Then I took care to walk over it in the very early morning, that nothing should interfere with the thoughts and feelings that left to themselves would rise to the surface, and bring before me the recollections of the incidents and anticipations of the past, the realization of the present, and again the anticipations of the future.

It was a morning of wonderful beauty, and that walk alone will, in time to come, hold its place beside the memory of that ride alone over the same line, the interval being more than fifty years.

THE PNEUMATIC PROCESS OF SINKING A PIER.

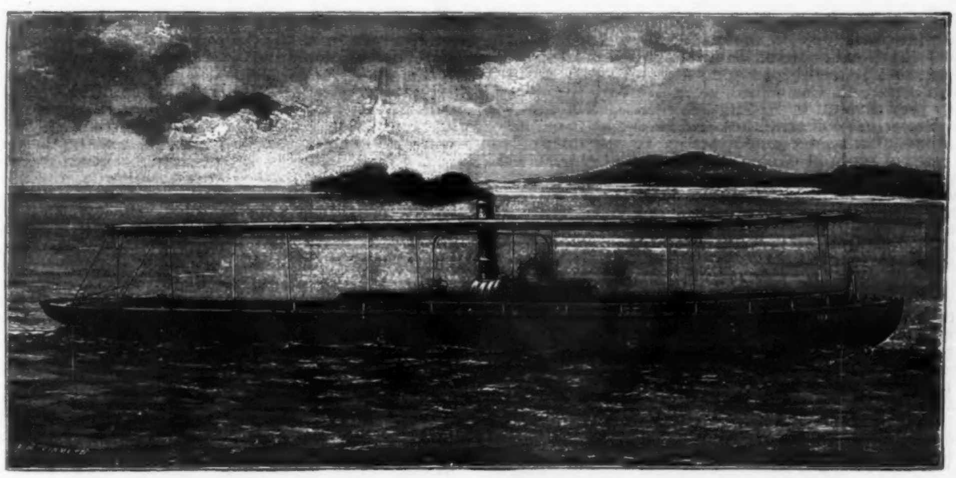
CONSIDERABLE has been said in a general way about the size and main features of an office building which the Manhattan Life Insurance Co. is about to erect in lower Broadway, New York, nearly opposite old Trinity Church. A former Rhode Islander, now engaged in business in New York, told the writer the other day that he had seen Broadway practically rebuilt since the war, and it will certainly be a cause for amazement to find Trinity's spire, once considered a landmark on account of its great height, overtopped by habitable floors of a building over the way.

The building is to be sixty-seven feet three and one-half inches wide on Broadway, sixty-six feet seven and three-fourths inches on New Street, 119 feet seven inches deep on the north line and 125 feet one-half inch deep on the south line. It will be sixteen stories high on the Broadway front and seventeen stories on New Street. The main building will have a height of 242 feet to the top of the main roof, and from the Broadway sidewalk to the base of the flagstaff on top of the dome the distance will be 348 feet. A few years ago it would have been impossible to erect a building as lofty as this is proposed to be upon such a site without surrendering so much of the lower floors to caring for the foundation load as to render them practically untenantable.

It is believed that the Tower building, a neighbor to the proposed new structure, was the first example of a tall building erected upon a narrow site in which foundation loads were properly carried without the surrender of this valuable ground space, and the lesson then learned has been turned to practical account since by metropolitan builders in many instances. The Man-

hattan building will be unique, however, in the adoption of two of the processes or principles of bridge construction, the pneumatic process of sinking a pier and the cantilever principle of distributing the load of the columns over the piers formed by the caissons. Fifty or sixty feet from the surface is rock which it was desired to reach with the foundations. The rock was covered with mud and quicksand. The building line upon each side was bounded by existing structures, some of them upon pile foundations, and it was of the greatest importance that these foundations should be protected and supported.

It is stated that small caissons had been employed in sinking foundations for one of the theater buildings recently erected in New York, but they were put down by mechanical means, no air pressure being employed, and in magnitude and importance they bore very slight comparison to the undertaking now in progress. The caisson considered as an aid to sinking foundations through wet material consists of an inverted box having a sectional shape according to the work it is intended to do. The principle is, that so long as the air pressure in this box is maintained equal to or slightly above the water pressure upon the outside down to the lower edge of the caisson, water cannot enter. Work is carried on in the chamber formed by the caisson, in many cases the work of laying the masonry on top of the caisson being carried on at the same time. As excavations advance the caisson sinks, the air pressure in the inside being reduced slightly until the dead weight of the caisson itself and the masonry on its top are sufficient to overcome the frictional grip or resistance due to the bearing upon the outside surface of the material it is passing through. There are fifteen caissons, some of the largest being twenty-five feet six inches by twenty-one feet six inches, twenty-five feet by fifteen feet six inches, and thirty-six feet by eleven feet. The air pressure is not expected to exceed twelve to fifteen pounds to the square inch, equivalent to twenty-seven to thirty-four feet head of water. After caissons have been sunk to the bed rock they are to be cleaned out and filled with concrete, thus forming a continuous masonry pier from the rock up to the surface of the ground. On these rest thirty-two main columns carrying the building, the load being brought to the center of the top of each pier by a system of cantilevers of plate girders built up in box form. This system is so thoroughly worked out in all its details that although at some places end columns are outside of the outside edges of their respective caissons, the load they bear is transferred by means of the cantilevers and bolster shoes so as to be evenly distributed over the base of the piers formed by these caissons.—*Providence Journal.*



SHALLOW DRAUGHT STEAMER FOR THE ZAMBESI.

A SHALLOW DRAUGHT STEAMER.

WE illustrate a small and very light-draught steamer recently constructed for the navigation of the Zambesi in East Africa, by Messrs. Yarrow & Co. This is a boat propelled by a single screw, 45 ft. in length by 7 ft. beam, yet not drawing more than 12 in. of water. The bottom of the hull is perfectly flat and the bow spoon shaped. Steam is generated in a horizontal boiler, and the engine is of the simple high-pressure inverted type, driving a screw about 2 ft. in diameter. To immerse this size of screw in a boat of the usual form would necessitate a draught aft of at least 2 ft., but in the class of vessel we have before us the water is sucked up, as it were, into a raised tunnel built into the bottom of the boat, and the propeller revolves in it, and is consequently not only entirely immersed, but also well protected from injury.

The extreme draught is only 12 in., which is a system not sufficiently well known, but nevertheless which has been adopted in few instances for many years past. When building the first steamers on this principle, special arrangements were made for keeping the tunnel full of water by exhausting the air out of the upper part of it. The action of the propeller suffices to draw up the water and drive the air out at the after end of the tunnel. On trial in the Thames, a speed of seven to eight miles an hour was easily maintained, and the towing power of the boat was excellent. This little vessel is capable of seating comfortably about thirty-five passengers, but it is mainly intended for towing small native barges. There is a wooden awning extending the whole length, as will be seen, to serve as a protection against sun and rain. The steering wheel is forward as usual in vessels for tortuous rivers where a good lookout for snags, etc., is of the utmost importance. The hull is constructed of galvanized steel, which is the most durable material for African river steamers.
—*The Engineer.*

THE CONVERSAZIONE OF THE ROYAL SOCIETY.

AT the recent annual conversazione of the Royal Society, London, Mr. J. W. Swan exhibited specimens of electrolytic copper, deposited in the presence of traces of colloid matter in the solution, a branch of research scarcely at all explored, and what little has been done has almost altogether been effected in a slightly different direction, namely, that of the influence of colloids upon ordinary crystallization. *The Engineer* says Mr. Swan exhibited specimens of electrolytic copper deposited bright on the surface the more distant from the copper plate on which the metal was thrown down. His specimens consisted of a series of electrolytic copper deposits, showing the great change produced in the character of the deposited metal by the addition of a minute quantity of colloid matter to an acid solution of sulphate of copper. The deposits produced from the solution containing the colloid are not only bright instead of being dull, but they are also much harder and more elastic than ordinary electrolytic copper. One specimen was a deposit from a normal solution of cupric sulphate of 1·15 specific gravity, containing 2·5 volumes of sulphuric acid in 100 volumes of solution; the deposit, as usual, was dull on the surface nearer to the solution, and would have been duller had the deposit been thicker. He also exhibited deposits from the same solution thrown down upon the same receiving plate, with the difference that more or less syntonized gelatine had been added to the solution, that is to say, gelatine which had been partially oxidized by means of nitric acid. The proportions of organic matter thus added were exceedingly small, varying from two parts in 100,000 to thirty parts in 100,000. Twelve parts in 100,000 were found to be sufficient to completely change the surface of the deposit from dead to bright. Larger proportions make the copper springy, so that the thin films will split of their own accord from the plate on which they are thrown down. Information as to the effect of heat upon these films would be interesting, to indicate whether the ordinary characteristics of the metal have been altered, or whether traces of organic matter which can be carbonized are at the root of the matter. Mr. Carey Lea's theory of his colored modifications of silver, are—despite his high authority—not so generally accepted in this country as his conclusions about his other valuable researches. Many here believe the colors to be due to traces of organic matter, and Mr. Swan's experiments show that traces of foreign matter will affect the physical condition of copper. A German chemist discovered a generation ago that one-tenth per cent. of lead in gold will make the latter brittle; so inorganic substances sometimes act in a similar way in modifying physical conditions.

Dr. Gorham exhibited a new reflecting kaleidoscope, represented in Fig. 1. It is an instrument adapted to

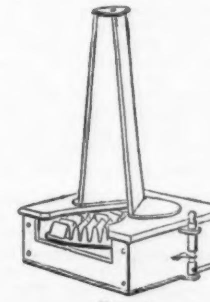


FIG. 1.

exemplify some of the theories in optics connected with the reflections of light. Two mirrors are thrown open to admit the light upon them and the objects. The objects themselves have a definite shape to cause them to reflect oblique rays of light only, while the light falls upon them from above, instead of being transmitted through them from below. These objects consist of strips of card bent backward and forward into hollows and elevations, upon which the light falls obliquely. It is then received upon the mirrors and reflected from them to the eye. The experiments showed: 1. Gray tones from oblique white surfaces. 2. Tints and shades of color from oblique colored surfaces. 3. Depth, intensity and brilliancy by repeated reflections. 4. Luster.

One of the most interesting exhibitions was a lantern stereoscope invented by Mr. John Anderton, and described by Mr. W. Bayley Marshall. For years "lanternists" have been trying to throw pictures of large size upon a screen, and to make them stand out solidly to the view of the spectators in a large hall. Several ways are known of so doing, but so far as we know, all of them are either expensive in appliances or involve such a loss of light as to be objectionable. In Mr. Anderton's invention, the images of a pair of stereoscopic transparencies are approximately superposed on a 10 ft. screen, and the beams of light from two lanterns are polarized in planes at right angles to each other. The picture is viewed through a pair of analyzers, similar externally to a small opera glass, and a true stereoscopic effect obtained. The optical system is in principle represented by Fig. 2, in which A is the

radiant, B the ordinary lantern condenser, E the slide, H the projection lens, and K a bundle of plates of glass inclined at the polarizing angle. Two lanterns are used, and the two images on the screen are not exactly superposed; for example, a beast—a zoological garden beast—has eight legs upon the screen instead of four. This confused double picture upon the screen is, however, viewed by an analyzer held in the hand of each observer, which analyzer permits but one of the pictures upon the screen to be seen by the one eye and the other picture by the other eye. The external form of the analyzer is represented in Fig. 3; the optical part of this consists but of bundles of pieces of plane glass; hence its cheapness, which is a great point when a portion of the apparatus has to be placed in the hands of each of a large number of persons at one time. With but ½ cwt. of stated pressure in the gas cylinders, a good, bright stereoscopic effect was obtained, and with colored as well as uncolored slides. Some rather unexpected effects are produced; for instance, in a representation upon the screen of prancing horses, if an observer viewing it through the analyzer move along the room in a plane parallel to the picture, the horses appear to turn in his direction. One does not expect to see wild beasts, whether inside or outside cages, at the end of a drawing room or public theater with the ordinary decorations; hence it is evident that, to make the illusion more complete, a hall for the purpose should be all dark or black at the end, and preferably, so that one looks at the pictures as through a short tunnel, such as Daguerre improvised when giving scenic entertainments in Paris, before he became famous

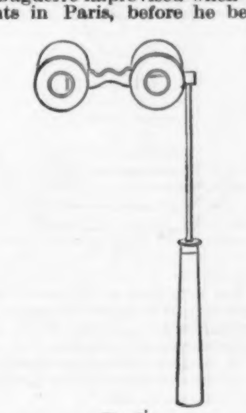


Fig. 3

in another direction. At all events the problem of producing large stereoscopic effects, simply and cheaply, either in private or in public, seems to have been solved by this invention.

Mr. W. H. Preece exhibited some submarine borers and specimens of submarine cables damaged by them. The face of a borer shown under the microscope was grave and obstinate, psychologically considered; it was something half way between the face of an owl and of an English judge; its mouth differentiated it from the face of an owl. Mr. Preece stated that the *Xylophaga* and *Limnoria terebrans* have proved serious and expensive depredators in tropical seas, but while twenty years ago Limnoria was practically unknown in our English waters, it has now gradually spread all around our coasts, and cables have to be served with brass tape to be protected from its attacks. Some stones pierced by *Saxicava rugosa* were also shown; these were from the Plymouth breakwater.

Professor J. Norman Lockyer exhibited by optical projection some photographs of the localities selected and the instruments used in Brazil and Africa during the last eclipse of the sun, also some photographs showing the results obtained. Nothing was said as to any points new to science discovered, except that attention was drawn by him to a curious curved line in some of the spectroscopic photographs. The Joint Eclipse Committee also exhibited some of the actual photographs.

Mr. W. A. Shenstone and Mr. M. Priest exhibited some highly complex apparatus used for studying the action of the electric discharge on oxygen. A known volume of oxygen at known temperature and pressure is exposed to the "glow" discharge at known difference of potential. The change of pressure is read by a mercury manometer, and from this the proportion of ozone is calculated. The use of the mercury manometer, hitherto impossible, makes this method very accurate, and by means of it our knowledge of the influence of various conditions (such as difference of potential, rapidity of discharge) has been considerably extended. It is found that under equal conditions a coil is more effective than a Wimshurst or Voss machine. The using of mercury in the manometer is made possible by protecting it from the ozone by placing a rod of

silver in the tube connecting the ozone generator and the manometer.

Mr. W. M. Conway exhibited by optical projection some photographic lantern pictures of the scenery of the Baltoro glacier in the Karakoram Mountains, Kashmir, in 1892. Some of them were taken from the summit of the Pioneer Peak, 22,500 feet high, which he believed to be the greatest altitude yet climbed anywhere.

Sir David Salomons, Bart., and Mr. L. Pyke exhibited some high-tension electrical experiments, in which discharges were sent through a number of vacuum tubes of different degrees of exhaustion. When the tubes were coupled in parallel, varied degrees of brilliancy were obtained, and when the same tubes were connected in series, the degrees of exhaustion which in the first case gave most brilliancy, in the latter mode of connection gave least. They also exhibited a small closed magnetic circuit transformer lighting three tubes with bunch electrodes, specially constructed for heavy discharge; the coupling was by their parallel inductive method.

The president of the Royal Society, Lord Kelvin, exhibited some physical illustrations of the molecular tactics of a crystal.

Mr. Edward Whymper exhibited the Corry "protected" aneroid, newly and specially designed for use in mountain travel, or for aeronauts. This form of mountain aneroid is designed to avoid the inaccuracies which result from continued exposure to low atmospheric pressure. It is inclosed in a perfectly air-tight outer case, and the internal atmosphere is kept at about a normal pressure at all times, except when an observation is to be taken, and then the cock is opened and communication with the external atmosphere is established. After taking a reading, the pressure is restored to the normal by means of a small force pump. The conditions thus correspond to those which originally obtained, when the aneroid was graduated under the air-pump receiver.

The next item of interest to which we think it well to draw attention, is one which is always on view at the Royal Society, consequently perhaps little noticed by the press, namely, one of the earliest reflecting telescopes, and made by Newton's own hands. He presented it to the Royal Society about the end of 1671, and it attracted the attention and approval of Charles II. The telescope is represented in Fig. 4. Its little metal-

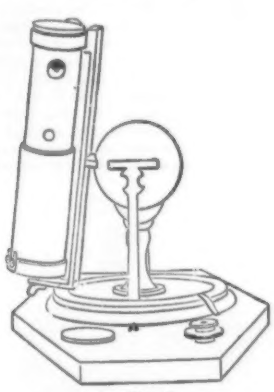


Fig. 4

lic speculum has a radius of 12⅔ or 13 inches, consequently its focal length is about 6¼ inches; in the tube is a little plane mirror at an angle of 45°, and the telescope has a plano-convex eyepiece; it magnifies 38 times. Upon it is the following inscription: "The first reflecting telescope invented by Sir Isaac Newton, and made with his own hands."

As a matter of fact, Mr. James Gregory, of Aberdeen, made the first reflecting telescope, and described it in his *Optica Promota*, printed in 1663. Newton's first reflecting telescope was smaller than the one possessed by the Royal Society; the first one was made in 1668; it was 6 inches long, and had a speculum with an aperture of rather more than 1 inch. With it Newton saw Jupiter distinctly round, his four satellites were visible, and the "moon-like phase of Venus" was also to be seen by its aid. Martin Mersenne, a French mathematician, seems to have first had the idea of a reflecting telescope, and suggested it in some letters to Des Cartes a little before 1640.

One of the most popular exhibits at the conversazione consisted of specimens of living Canadian walking-stick insects, *Diapheromera fermorata*, exhibited by the Zoological Society of London. They were hatched from eggs laid in the insect house of the society. They are about 3 inches long, and average, perhaps, $\frac{1}{16}$ or $\frac{1}{10}$ inch in diameter, and they walk on long, slender, hair-like legs. They have been reared in the gardens on hazel leaves, but have not fattened thereupon.

Mr. Edwin Edser exhibited some apparatus to illustrate Professor Michelson's method of producing interference bands, which method is likely to be of great value in scientific research. His method was described in these pages shortly after he had read his paper thereupon at the last meeting of the British Association. In Mr. Edser's modification light is allowed to fall on a mirror thinly silvered, so that about half of the light is reflected and half transmitted. The two rays pursue paths which are mutually perpendicular, are reflected back by two ordinary mirrors, and on meeting, interfere. The interference bands can be projected on a screen, and this fact, together with the simplicity of the arrangements, makes the method useful for lecture illustration.

Professor Henrici exhibited a harmonic analyzer, constructed by Mr. G. Coradi, of Zurich, according to instructions from Professor Henrici and Mr. Sharpe. The instrument gives, on going once over a curve, the first five terms of the expansion in Fourier's series, and on going twice more over the curve, it gives five additional terms. The constant term is not given.

Mr. C. J. Woodward exhibited some apparatus to indicate the phenomenon of the interference of waves of sound. The Karakoram Mountain Survey Expedition exhibited some water-color drawings of the scenery of the Karakoram Mountains, Kashmir, by Mr. A. D. McCormick. These drawings were made at altitudes of from 15,000 to 20,000 feet during the expedition in 1892. Professor Osborne Reynolds exhibited a textile fabric contrivance giving motions analogous to vortex ring in fluids. Mr. A. A. C. Swinton exhibited some more of his high frequency electric experiments. Professor Thorpe exhibited some autotype enlargements from photographs illustrative of the recent African eclipse expedition. The Rev. F. J. Smith exhibited some more of his inductoscripts. The Egypt Exploration Fund Archæological Survey exhibited some water-color drawings executed by its artists. Professor Norman Lockyer exhibited photographic spectra of some of the brighter stars, and Major P. A. McMahon exhibited a new method of obtaining designs for tesselated pavements.

Captain McEvoy exhibited his hydrophone. A heavy iron vessel containing the transmitting part of the apparatus may be sunk from one to five miles out at sea, and it is connected by means of an electric cable with the receiving station on shore. When a torpedo or other boat driven by steam gets within half a mile of the transmitting apparatus in the submerged case, signals of various kinds are transmitted to the land, and by means of the telephone the beats of the paddles or of the screw of a boat can be heard. Some main features of the apparatus were not made public. A very light pendulum seemed to be the body taking up the vibrations inside the case.

THE CHOLERA EPIDEMIC.

"MIXED INFECTION" IN CHOLERA.

THE *Vratch* of January 7 contains a report by Professor M. Nencki on the work done in St. Petersburg Imperial Institute of Experimental Medicine during the cholera epidemic of last year. At the very beginning of the outbreak the institute was enabled, by the kindness of Prince Alexander of Oldenburg, to establish two temporary branches for practical work at Baku and at Astrakhan, and to furnish them with the necessary apparatus and instruments for bacteriological investigation, as well as with a large supply of old and new remedies for the disease. As the result of these investigations, Dr. Blachstein and Dr. Shebenko came to the conclusion that the infection of Asiatic cholera is due, not to the action of the comma bacillus alone, but to its co-operation with other microbes. They found in the stools of a large number of patients suffering from typhoid cholera, and sometimes also in cases of typical cholera, three kinds of short bacilli, which they named bacterium Caspicum *a*, B1, and B2. The bacterium Caspicum *a* does not liquefy gelatine. It is very difficult to distinguish this bacterium from the bacterium coli commune and from the bacillus of typhoid. The bacterium Caspicum B1 is chiefly found in cases of typhoid cholera, but now and then also in typical cholera it liquefies gelatine. The bacterium Caspicum B2 was obtained from the contents of the small intestine of a person who died from typical cholera. It acts on gelatine like the foregoing, from which it differs very little, and it is possible that both the kinds last mentioned are identical. Dr. Blachstein states that, after subcutaneous injections of bouillon inoculated with the discharges of a cholera patient, mice and rabbits died in 24 to 36 hours. On the other hand, injections of a pure culture of comma bacilli or of pure cultures of the three species of Caspic bacilli, taken separately, did not cause death. This observation is in accordance with that previously made by Bouchard. Dr. Blachstein prepared artificially pathogenic mixtures in which the comma bacillus and some of the other kinds of intestinal bacilli were present. These mixed cultures were obtained either by inoculating a 24 hours old culture of one of the other microbes with the comma bacillus, or by placing one of the other bacilli in the culture of comma bacillus, and it is observed that mixtures obtained in the former way were more virulent than those prepared in the latter. Experiments on mice always gave uniform and positive results, illustrating the fact that the comma bacillus, in combination with some of a large number of other bacteria, is able to kill mice, while in the same animals pure cultures of any single kind give negative results.

The Caspic bacillus *a plus* comma bacillus kills rabbits and pigeons; bacillus Caspicus B2 *plus* comma bacillus kills only mice and guinea pigs. The mixed cultures were generally injected in the quantity of 0·1 cubic centimeter into the mice; the rabbits were inoculated with 2 cubic centimeters. Death quickly ensued, generally within 24 hours.

Dr. Blachstein, in collaboration with Dr. Zunft, succeeded in obtaining from the water supply in St. Petersburg a bacterium which by itself was quite innocuous, but which, mixed with the comma bacillus, caused the death of animals. A mixture of comma bacillus with the bacterium coli commune obtained from the contents of the intestines of a cow killed pigeons. The comma bacillus grows very well in a pure culture of bacterium coli, and in growing displaces the latter so effectually that within a week no trace whatever of it remains.

With regard to the other mixed cultures, it was found that the comma bacillus entirely disappears in a culture of bacterium Caspicum, and within 36 to 48 hours; on the other hand, transferred into a culture of bacterium, B1, it first develops abundantly, but soon stops in its development, and after two or three days disappears, and leaves the place to its companion. A growth of the inoculated comma bacillus in the bodies of animals was not observed by them; on one occasion only Blachstein and Zunft succeeded in recovering the cholera bacillus from the place of inoculation.

In Professor Nencki's opinion, neither Koch nor his followers have given sufficient attention to the importance of bacteria other than the comma bacillus in the infection of cholera. He thinks it clear that other bacteria in some way or other increase the virulence of the comma bacillus. Nencki believes that if Pettenkofer and Emmerich, instead of drinking a pure culture of comma bacilli, had taken one of the mixtures mentioned above, they would not have escaped with so light a form of cholera. For the treatment of cholera, Nencki recommends B-naphthol-bismuth, especially in the first stages of the disease. He also found pine tar an excellent disinfectant.

DUODENAL SECRETION AND DIGESTION.

By Dr. G. ARCHIE STOCKWELL, F.Z.S.

WHILE for some time it has been generally thought that the functions of digestion and assimilation were thoroughly mastered both from chemical and physiological points of view, it has, nevertheless, been understood by working physiologists that a missing link existed—that there were certain phenomena continually manifesting themselves which did not tally with generally accepted ideas; notably, that the complex substance termed pancreatin (made up of *trypsin*, *amylopsin* and *steapsin*), which in consonance with all teaching should be destroyed in the stomach, on the contrary, on investigation frequently gave results that did not uphold this view; and also that when a mixture of pancreatin, pepsin, and hydrochloric and lactic acids is ingested by the mouth, therapeutic effects are induced that do not obtain in the least degree when the first named substance is eradicated. Consequently, it is evident there is a serious error in physiological teaching, and particularly in connection with the function of digestion in so far as it takes place in the intestinal tract of mammals.

Recently the statement appeared in a new edition of a volume on therapeutics, that the action of mercurous chloride (calomel) depended solely upon its transformation into a black oxide by contact with the alkaline juices of the duodenum—that the activity, therefore, in fact, was not due to the calomel *per se*, but to the oxide.

Such teaching cannot but be pernicious, since it has no better basis than mere assumption, being derived neither from physiological theory nor fact; and a very little knowledge of the mercurial salts would have saved the author from an accusation of unpardonable ignorance. Again, it may be added, the action and transformation of this particular salt of mercury (the mild chloride) is by no means definitely understood; indeed, for many years it has been a question of dispute. It has generally been believed, however, that the transformation of this medicament takes place in the larger intestines instead of the duodenum, and consequently, after its physiological fact has been manifested, it is changed into the black or sub-sulphuret (Æthops mineral),* but in this connection it must be remembered that both the black oxide and sub-sulphuret of mercury are, at best, admitted to be possessed of but very little therapeutic activity; so little, in fact, that both are commonly believed to be wholly inert, for which reason they have long since been dropped from all civilized pharmacopœias.

The general teaching of schools and text-books is that all secretions of the *primæ viæ* below the pyloric orifice, and especially of the duodenum or "second stomach," are invariably alkaline. Experimenters who have made pancreatic fistulæ, whereby the pancreatic fluid is made to flow through a cannula, outside the body and into a specially prepared receptacle, have certainly noticed this peculiarity, but they have not, however, taken into consideration the possible changes that may follow as the result of contact of the secretion with the oxygen of the outer atmosphere. Continually, too, is reiterated the statement that while pepsin requires for its proteolytic activity a medium most decidedly acid in character, the complex substance denominated pancreatin can only act in the presence of alkaline media—that the pancreatin is necessarily destroyed when brought into the presence of an acid.

I am now prepared to prove the function of digestion within the duodenum, far from being an alkaline process, is distinctly an acid one; that, moreover, the pancreatic fluid in its normal condition is *never* alkaline, but reacts in greater or less degree, according to circumstances, to blue litmus paper.

Dalton, Flint, Foster, and others are responsible for the statement that the pancreatic juice is alkaline, apparently unaware of the fact that it is *normally* acid and only becomes neutral and then alkaline on contact with oxygen, as upon exposure to atmosphere. Another source of error is the supposed relationship between the pancreatic fluid and the secretion of the salivary gland, as judged by the action of both upon starch, especially within the test tube of the laboratory.

Time and space will not permit, at this juncture, of going into the details of the experiments that have led to the discovery above outlined, viz., that the secretion of the duodenum, in state of health, or when normally functionating, is invariably acid; nor do I pretend to say when all function is in abeyance, the alkaline reaction is not sometimes possible, since it has frequently been found so, especially when the secretion of the gall duct preponderates; just so when perfectly quiescent the gastric secretion proper is likewise often found alkaline; and the reasons for alkalinity, in both instances, are most obvious; I will, therefore, in conclusion, merely confine myself to outline.

For some years it has been my good fortune to be retained as the confidential medical adviser of a well known pharmaceutical house. Some three years since, this house endeavored to secure a pill coating which would be impervious to the action of gastric fluid, and, at the same time, readily soluble in the duodenum or beyond. Already experiments had been made in this direction in Germany and France, with a product obtained by exhausting horny matters, such as bristles, nails, horns, and epidermal tissues, successively with alcohol, water, and dilute acids, the result being an albuminous substance known commercially as keratin. These experiments, however, have never proved satisfactory, and never fully filled the above requirements owing to several causes—chiefly that a large number of medicaments were decomposed by contact with the fluids which were necessarily employed to render the coating insoluble; that a pill mass containing water caused keratin to shrink and crack into fissures; that the process of coating was one which did not permit the pill to be fixed on the point of a needle, since it left an opening in the coating that could never be completely closed; finally, in a large majority of instances, it was found keratin-coated pills passed through the entire length of the bowel undissolved.

A chemist in the employ of the house before referred to, undertook to supply the desired pill coating from the

* *Vide* National Dispensatory.

standpoint of his profession, and finally submitted a number of spherules enveloped in a thin varnish of shellac and tolu, his theory being based upon the supposition that the gastric fluid must, under all circumstances and all conditions, both in health and disease, be necessarily acid; and that likewise, under like circumstances and conditions, the secretion of the duodenum is necessarily alkaline. In proof the utility of his discovery, he exhibited a series of test tubes, some containing artificial gastric juice, others a 1 per cent. solution of sodium bicarbonate, in the former of which the pills covered with the tolu-shellac coating remained intact, while in the latter they speedily disintegrated.

The general manager of the house before referred to, on several occasions, had opportunities to observe in his own person, especially in connection with the employment of digestive ferments, that the chemistry of the test tube and laboratory by no means produced results identical with the chemistry of digestion as manifested within the human economy. He, therefore, was somewhat skeptical as to the report of the chemist, and requested further investigation, and from a purely physiological standpoint, at my hands.

On general grounds, I had always believed the secretions of the intestines to be acid, or perhaps nearly neutral, but had forgotten whether any positive teaching had ever been promulgated on this point. To be sure, the medical press frequently reiterated as a well-known fact the alkalinity of the intestinal secretion, but as these periodicals, in the main, are established for other than scientific purposes—conducted in the interests of advertisers solely, and neither their editors nor contributors, as a rule, representatives of the better medical talent of the country, or men to whom original investigation is familiar—I gave the matter little thought; and, moreover, these claims, I was well aware, were for the most part advanced in the interests of manufacturers of digestive ferments.

Delving into text books in search of evidence of the alkalinity of the intestinal and duodenal secretions, or tracing back, I was surprised to find the theory originally expressed as a *possibility* only—as a bit of guesswork with no better foundation than the "three black crows," and that had grown by constant repetition; that later physiologists, while accepting and boldly advancing the idea, had been at no pains to seek its verification, except as such might present itself as a side issue, as, for instance, through pancreatic fistulæ. The only experiments that I could unearth were of the character of those of the chemist before mentioned, and consequently bore no reference to digestive chemistry as it obtains within the animal economy.

Instituting a number of experiments upon dogs, it was found the shellac-tolu coating did not dissolve within the stomach. *Neither did it dissolve in the intestines.* Tartar emetic pills of from one-quarter to ten grains each, and administered in various degrees of dosage, had no effect upon dogs of eight pounds weight and upward; pills of morphine, and likewise a sulphide of calcium with like coating, were equally negative in results. Subsequent and duplicate experiments upon a series of individuals by means of like coated spherules of tartar emetic, podophyllin, etc., in varying doses, were no more satisfactory. Further, as a means of control in each instance, an equal number of men or dogs were selected who received pills without the coating. The negatives in one experiment, as a rule, became the positives in the next, and *vice versa.*

Next was undertaken vivisections during all stages of digestion of food and ingestion of pills, and these revealed the intestinal secretion, including that of the duodenum, to be unvaryingly—though sometimes but faintly—*acid*, depending more or less upon the stage of the function; that when the digestive function was wholly idle, and the intestines and stomach entirely empty, likewise the pancreatic secretion either totally inhibited or in abeyance while that of the liver persisted, there might, sometimes, be temporary but slight alkalinity that rarely extended further than the lower part of the jejunum. Incision of the pancreas *in situ* at the origin of the ducts gave an acid reaction of secretion; pancreatic fluid almost instantaneously became first neutral, then alkaline, on contact with air, and such, gathered by means of fistulæ, presented the latter reaction most markedly after a few seconds' exposure.

Experiments were made upon dogs at a time when their lacteals were congested and distended as the result of the absorption of digested milk, and while abundance of this fluid still remained in the duodenum to the exclusion of all other fluids—this being the time when the majority of writers insisted upon an alkaline condition of the duodenum—yet an acid reaction was found to invariably obtain throughout the intestinal tract.

Again, on various occasions, alkalinized milk was digested with the so-called pancreatin (duly rendered alkaline) of commerce, yet the result was invariably the same—the end product was acid!

Like experiments made with various other substances, especially beef peptone, not only in condition of alkalinity, but sometimes neutral, only induced like results. In the same way, milk and beef peptone, when brought into the presence of pancreatic secretions obtained by means of pancreatic fistula, differed in no way, save in the time necessary to produce the acid end product. The most marked evidence was obtained by making a pancreatic fistula and introducing the free end of the tube into a bottle of milk.

These experiments have been repeated again and again during a period of three years, with unvarying results.

Recently, in conversation with Dr. O. W. Owen, late Professor of Physiology in the Detroit Medical College, I was pleased to learn that he also had been engaged in experiments of like nature, and had obtained precisely parallel results. On one occasion, accepting the statement of the alkalinity of the intestinal and duodenal fluids, he endeavored to demonstrate the same by means of a vivisection before his class, when, to his surprise, an acid instead of an alkaline condition was revealed. Conceiving this to be an error, the result of accident perhaps—that possibly the knife which opened the duodenum, and before had been employed to incise the stomach, was at fault, or that possibly accidental pressure upon the stomach might have forced a portion of the gastric juice into the bowel immediately contiguous—he introduced to the table another dog, and with a new and perfectly clean instrument, opened the abdomen from below upward, in order to avoid any possible passage of fluid from the stomach, then segregated the duodenum just below the pyloric orifice by means of a ligature, and then only incised. The result was as before, distinctly acid, a condition which persisted until the lower rectum was reached, where, owing to the existence of special glands peculiar to canines, an alkaline condition obtained—and invariably obtains—a condition that is not found in man.

This experiment was repeated on many occasions. He also experimented regarding digestion on the same lines with myself. The results in each and every case were identical and confirmative, and no amount of control in any way contravened.

As the experiments of Dr. Owen and myself extended far into the hundreds, and in each instance, where possible, were carefully guarded by control, and the results unvarying, there can be no doubt of the correctness thereof and of the conclusion that the normal secretion of the intestine in mammals (*Carnivoræ* and *Omnivoræ* at least), including that of the duodenum, is acid; that duodenal digestion is an acid and not an alkaline function, also that the accepted views regarding the utility of pancreatin (so called) are based upon false premises resulting from imperfect knowledge and experimentation.

I may here say that since these experiments were performed, I have made a very exhaustive, thorough, and careful research of modern literature, and, as before remarked, can find no evidence that has ever been offered as to the alkalinity of the intestinal tract, except mere supposition, which by repetition has been accepted as fact; I may also add that in one instance it was found Claude Bernard, who had made extensive investigation in this direction, declared the intestinal tract was invariably acid throughout its length. Therefore, neither Dr. Owen nor myself can claim an absolute discovery, but our researches must be of value as a reaffirmation of a fact that has been forgotten or escaped notice.

I may here remark that this evidence regarding the acidity of the intestinal secretion placed the matter of a pill coating that will dissolve only after the medicament has passed the pyloric orifice, upon an entirely different basis. Subsequent study and experimentation, however, secured the desired result in this direction, but this it is not necessary to explain, since it is a matter that pertains solely to the firm in whose interest it was evolved; further, I have not thought it of sufficient moment in this connection to have solicited their permission to make public the details of this process, though I have no doubt such would have been granted, since it has always been their rule never to surround with secrecy, or secure monopoly by copyright, patent, etc., their formulæ or undertakings.

650 Congress St. E., Detroit, Mich.

NOURISHMENT IN ACUTE DISEASE.*

By FRANCIS H. WILLIAMS, M.D.

THERE are few questions in the treatment of disease which have to be decided so often during the daily routine of practice as those which concern the proper support and nourishment of the patient, and further, there are not many things connected with the care of patients which are so difficult.

It is not easy to find a person competent to prepare suitable food; it is, therefore, the more incumbent upon the physician to be able to give proper directions for its preparation.

The chief thing is to take pains, and those who can do this are rare people, whether physicians, relatives, or nurses. This is why less is accomplished than there should be in the support of the sick. If we wish to succeed in avoiding nausea, vomiting, and loss of strength, and even loss of life, we must learn to offer nourishment to our patients in a suitable form.

It will be my endeavor to call to your minds a few of the principles to be kept in view in feeding patients acutely ill.

Food may be classified as follows:

(1) Water, (2) salts, (3) fats, (4) sugars (fruit), (5) starches, (6) albuminoids.

The classes of food known as starches and albuminoids are the ones which require the most care to offer to a patient in a proper form.

Water is of prime importance. Consider for a moment the composition of the body of a man weighing 154 pounds, as illustrated by these blocks. He is 108 pounds water, or about two-thirds.

It does not follow from this that we need to give every patient several pints of water a day; by no means; but it is fair to infer that water of a suitable temperature should not be denied the sick, and that patients too young, too delirious, or too ill to ask, should not be neglected in this regard. The physician should see to it that water is offered the thirsty economy in all cases, nature demanding it, though the patient makes no request.

Salts are present in small proportion in most foods, and are essential constituents of our foods.

Fats as a rule are not tolerated by patients acutely ill, and their use should be limited to such forms as are finely divided, as in milk or yelk of egg (and even in milk it may be necessary to reduce the amount of fat by skimming off the cream).

Common sugar is rapidly and perfectly changed into grape sugar, and into maltose, before it is assimilated.

Grape sugar and maltose are very soluble, and for this reason seem a very desirable form in which to give nourishment. Horlick's and Mellin's foods are examples of preparations made up chiefly of saccharine substances.

Fruits are valuable to give variety to the diet, and to contribute water, which they contain in large proportion. Most fruits contain eighty-five to ninety-odd per cent. of water, some sugar, and the citrates, malates and tartrates of potassium. Other fruits, such as grapes and bananas, contain sugar in considerable proportion, to twenty per cent., and their value as foods is not to be despised. Among dried fruits, dates and figs contain sixty per cent. of sugar, and six per cent. of albuminoids.

The value of certain fruits for persons who are predisposed to uric acid, gravel, and concretions in the bladder, I shall not discuss here, though it is well worthy of attention.

Though we take foods into the stomach in solid form, it is necessary that they be made soluble before they can be assimilated. The classes of foods which we have thus far considered are readily absorbed, namely, water, salts, fats, and sugars; they are all liquid or readily soluble substances. In the remaining classes, starches and albuminoids, we have foods with which there are several steps to be gone through before they can be taken up by the system.

With all starchy foods, like grains, potatoes, and rice, it is necessary to break the starch granules by heating, or some other simple process, and before the starch can be absorbed, it must be converted into a soluble substance, such as dextrine, which is the same in composition as starch. Starches, therefore, are not absorbed as such, but must first be rendered soluble.

Uncooked starches vary very much in the rapidity with which they can be converted into sugar by the action of the saliva. The starch of Indian corn is converted in three minutes, whereas wheat starch takes forty minutes, and potato starch three hours. After thorough cooking, all starches require nearly the same time. It is, therefore, important to have starchy food well cooked before it is given to patients.

Arrowroot forms, by cooking with water, a mucilaginous liquid, not a pasty mass; it is, therefore, not apt to irritate the stomach and intestines. It should, however, not be used alone for more than a few days together, as it contains too little of the other constituents of a proper diet. In this it differs from rice or potato bread, which contain gluten, salts, and fats in addition to starch. Rice is better steamed than boiled, as it loses to boiling water much that is valuable. Boiled potatoes are for the same reason less nutritious than baked ones.

As regards *albuminoids.* Wholly without albuminoids, unless the disease is of short duration, the patient cannot exist. Since they are imperatively needed they should not be omitted from the diet, even where digestion fails almost completely.

Albuminoids are complex in composition and decompose readily, and in their preparation more care is required than with any other kind of food. To avoid decomposition they should always be fresh; and to prevent losing the albuminoids by coagulation, they should not be heated to too high a point.

To prepare meat foods properly two things must be borne in mind: (1) Albuminoids, as a rule, coagulate when heated to boiling. (The casein of milk is an exception to this.) (2) To obtain a good meat flavor, the meat must be subjected to a temperature much above the coagulating point of albumen. It is, therefore, necessary to resort to two procedures, one which has for its object to extract the flavor, the other to extract the albuminoids without coagulating them.

If we treat meat with boiling water, we get beef tea, which contains only a small percentage of solids and almost no albuminoids. This applies to all clear beef tea. Beef tea is of service in two ways, its taste and odor are agreeable, and, together with the heat of hot water, which acts as a stimulant, it makes a valuable article for use in the sick room—not as food, but as a flavoring.

Some of the extracts of meat made with hot water may be used instead of the ordinary beef tea, thus saving much time. Liebig's, and probably similar extracts of beef, contain no fats, gelatine, or albumen. It is desirable to use only a small amount of extract, say one-third of a teaspoonful to a teacupful of hot water, as too much gives an unpleasant flavor.

Now as regards the juices of meat which contain albuminoids in solution.

From raw meat one cannot obtain as much juice as is easily expressed from the same amount of meat which has been previously heated. The reason is this: The envelope of the muscular tissue is a substance similar to gelatine, which swells and dissolves when heated, and thus after broiling the liquid portions of a steak flow out more readily. A steak when well broiled swells; if it is cooked too long, the albuminoids coagulate, it loses moisture, shrinks and becomes tough. A slightly broiled steak may be cut into square pieces, and pressed or squeezed or twisted in a piece of cotton cloth to extract the juice.

In administering beef juice great care should be exercised to avoid heating it to 136° F., at which point its albumen coagulates in flakes. Beef juice, though fourteen times as rich in albuminoids as beef tea, is so raw in flavor that it is rejected by many palates. To overcome this objection, it is only necessary to add a proper quantity of any extract of beef to make it delicious—about the size of an almond to an ounce of beef juice. Thus by a union of two bodies, one rich in albuminoids and the other rich in flavor, we get something that is superior to either. Beef juice is an excellent article of diet where solid food cannot be given, but is somewhat troublesome to prepare. A pound of meat yields about four ounces of juice; it therefore costs about five cents an ounce.

Soluble albumen, such as is contained in expressed meat juice, is absorbed in the rectum to nearly the same extent as complete peptones. Albuminoids in solution are not precipitated in the stomach, and afterward dissolved, except in the instance of casein milk, which, as already said, is first coagulated and then dissolved.

Being accustomed to prescribe meat juice, I was much pleased to find a preparation of it manufactured by a well known firm. I hoped in this to realize all the advantages of beef juice without its inconveniences. An analysis of this preparation, which was made for me, was disappointing, as it was found to contain only one-third of one per cent. of albuminoids, compared with seven per cent. of beef juice; it had also more salt than is desirable—twelve and one half per cent. This is mentioned to illustrate the advantage of using foods which are prepared at home in preference to those made by manufacturers, of which the composition is unknown. This preparation costs thirty-five cents per ounce, though it is only one-twentieth as rich in albuminoids as beef juice costing about five cents.

If one cannot conveniently get albuminoids from meat, a very nutritious broth may be made by means of hot water into which an egg has been stirred. Here we may heat three ounces of water to not above

* Abstract of a paper read before the Massachusetts Medical Society.

149° F., and stir in a raw egg. The liquid is milky if we use the yolk; clear if only the white is used. It has little taste, which is an advantage to many patients, or it may be flavored with beef extract.

If one has no thermometer at hand, the temperature of the water may be determined in two ways: If the finger can be kept in the water for two seconds, or about the time it takes to count ten hurriedly, the temperature is not too high. Liquid of this temperature is apt to burn the tongue; 140° F. is as hot as one can drink liquid, and 122° F. is a very comfortable temperature for a hot drink.

When these experiments were begun, it was feared that a temperature sufficient to coagulate albumen might be so low as to be lukewarm; but a few tests showed that any temperature which can be borne in the mouth will not coagulate albumen. (Though these two temperatures differ by only a few degrees.)

It is interesting to compare the composition of four liquids containing albuminoid constituents.

Beef tea.......................about ½ per cent.
Beef juice ....about 7 per cent.
Raw egg with three ounces of water....about 5 per cent. albumen, 6 per cent. fats.
Milk ...4 per cent. albumen, 4 per cent. fat, 4 per cent. sugar.

In all of these we get a good proportion of salts.

It may happen that the digestive organs cannot tolerate eggs, or more especially milk. But by means of powders which contain pancreatic ferments, such as Fairchild's peptonizing powders, milk may have its albumen converted into albuminoids, which do not coagulate by heat, and into diffusible albuminoids or peptones. In the ordinary process of peptonizing milk, both of these bodies are formed, but the proportion of peptones is small.

In the case of milk, which forms solid curds in the stomach, a partial conversion of its casein into albuminoids which do not coagulate has obvious advantages. Peptonized milk is so well known that I hesitate to do more than mention it to you; on the other hand, it is so useful a preparation that I will say a few words about it for such practitioners as may not appreciate its value, especially as there are a few precautions necessary to its successful use. The powder is put in a quart bottle, with little water; milk is added, and the whole is placed in a vessel of water about as warm as the hand. The process of partial digestion goes on while the milk is at this temperature; boiling stops it, cold delays and preserves it. If the digestion is continued in this way for twenty minutes or more, the milk has a bitter taste. If this taste is objected to by the patient, the time may be shortened to five minutes, or even less, in which case, however, the amount of artificial digestion is small. If the milk is given by the rectum, the digestion may be kept up for two hours; in this case the milk does not curdle when acids are added to it. About four quarts of peptonized milk will support a person in health. For a patient in bed less than this is sufficient, the amount varying with each individual.

Milk treated in this way contains albumoses and some peptones. For our purposes we may broadly define albumoses and peptones as soluble albuminoids, which cannot be coagulated by heat or dilute acids; and peptones have the further property of passing through the membrane of a dialyzer, and represent a later stage of digestion. Even after prolonged digestion, we get in peptonized milk only a small amount of peptones, the casein being converted chiefly into albumoses.

The bitter taste of peptonized milk is not thoroughly understood; albumen and albumoses are tasteless, and peptones have a cheesy taste.

Meat albuminoids are converted by the stomach into bodies which are soluble or diffusible, and these substances, when artificially produced, have been regarded as calculated to render service in invalid feeding.

It is known that an increased secretion of urea appears after the administration of peptones, just as it does after the ingestion of unaltered albumen, and that the chemical composition of peptones differs little from that of ordinary albuminous bodies. They have the manifest advantage of being easily and immediately absorbed. Peptones, so far as we yet know, may be used during short periods of extreme exhaustion, when perhaps few other albuminoids could be assimilated.

Many preparations have been offered for sale which purport to be peptones, but which really contain only a small amount of them. Many such preparations are soluble in water, but have a very disagreeable odor and unpleasant taste.

So much in outline for the various classes of foods.

Since acute disease is accompanied by fever, we must consider the effect of feeding in cases where the temperature is febrile in character; also the amount of food, its quality and quantity, together with other conditions affecting its absorption.

In acute disease accompanied by fever what are the conditions? The body loses weight, the urea especially is increased, and carbonic acid and water are excreted in larger amount than in health. All of this loss is not dangerous if allowed to go on for a few days only, and if the amount does not exceed certain limits.

But to replace these losses we are at a disadvantage as regards the ability of the system to assimilate food. In fevers the appetite is small, or may be completely lost. The saliva, the gastric juice, the pancreatic fluid, the bile, are less efficient in action, or are diminished in amount, during high temperature. The stomach is very sensitive, in part perhaps through sympathy with the increased sensitiveness of the nervous system as a whole.

If there is much hyperesthesia of the digestive tract, as in typhoid, in peritonitis, in dysentery or gastroenteritis, one must be careful not to give too much food, and it should be in liquid form. It is not, however, the administration of food, but the administration of unsuitable food, that we have to fear, and also the giving of nourishment in quantities unsuited to the digestive powers of the patient.

One should not give the patient what he cannot digest, nor should we give him less than he can assimilate. The attendant must have a constant watch over the condition of a patient's powers of digestion, and carefully adapt his food to his capabilities, especially during convalescence.

Our attention should be devoted not only to what is put into the alimentary canal, but also to what goes out. For example, if curds of undigested milk are found in the stools of a typhoid patient, the quantity of milk should be diminished, or it should be diluted.

Large quantities of milk are often given to typhoid fever patients, to their great detriment; and excess of zeal in feeding and too little care in the preparation of their food, cause much of the intestinal trouble that complicates these cases. In diphtheria, foods which are soft in consistency, rather than liquids, may be used, as they are less apt to get into the trachea.

Every careful observer of the sick will agree that many patients are starved in the midst of plenty, simply from want of attention to the ways which alone make it possible for them to take food. For example, if the patient has a fever with remissions or intermissions, it is of first importance to remember that the ability to digest food at these times is greater, and the more nourishing portions of the diet should be given during the remissions and intermissions.

As far as practicable, the mouth should be kept clean. The tongue may become cracked and dry. It may stick to the sides of the mouth and cause so much pain when the attempt is made to swallow that the patient refuses food which he would otherwise take. The mouth should be rinsed with water after taking food, and should be carefully cleansed with an antiseptic solution from time to time.

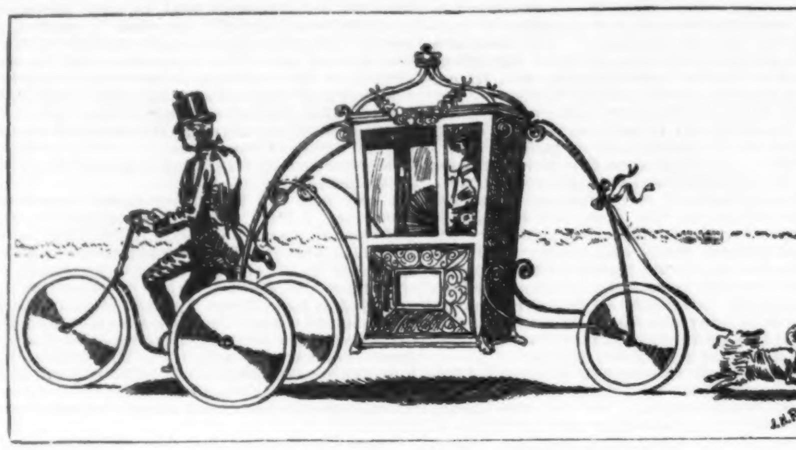
In a word, for extreme cases the important thing is liquid food. We should give water. We should give sugars (starches have no taste, but are less readily absorbed). Fats are not tolerated. Salts are present in nearly all foods. We should give albuminoids, in beef juice, in peptonized milk. Ordinary milk becomes solid in the stomach.

The physician should never lose sight of the patient's likes and dislikes; one cannot diet a patient from a book, or from the chemical composition of foods. On the other hand, it is incumbent on the physician to know how to choose such a variety in diet as to include both what is palatable and what will afford a proper amount of nourishment.

It has been one of the aims of this paper to show that the preparation of some valuable foods is entirely in our own hands, and that we need not be dependent upon manufactured preparations, of whose composition we are often ignorant; and, further, to emphasize many details concerning the nourishment of patients which, though well known and often repeated, are often neglected.—*Francis H. Williams, M.D., before the Massachusetts Medical Society.*

THE SEDAN CHAIR.

THEY say Sedan chairs are coming in again. Instead of hanging them on poles, why not on wheels? I inclose sketch illustrating the idea.—*Daily Graphic.*

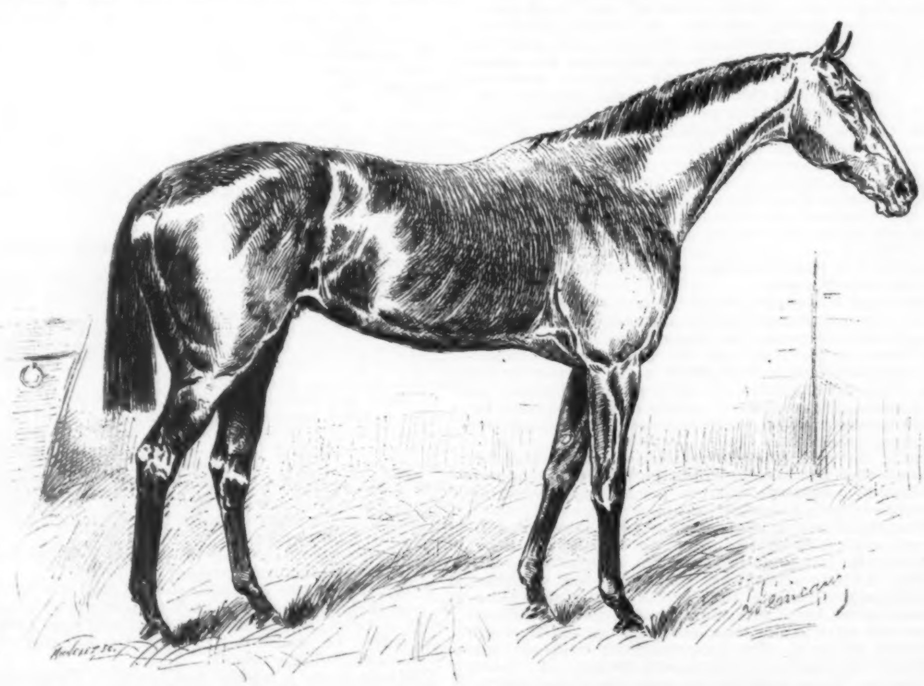


THE SEDAN CHAIR ON WHEELS.

THE GREAT PRIZE OF PARIS.

THANKS to Ragostky's nose, and thanks especially to the presence of mind and skill of his jockey, Tom Lane, who obliged him to elongate that nose just at the psychological moment, the great international test remains again this year to the French champion. But Baron de Schickler ought to esteem himself fortunate that Ravensbury, which alone represented the English element, found himself inclosed in the group at the entrance to the straight line—that is to say, at the place where he should have begun his effort. From the manner in which, obliged to make the tour of the other horses, he regained lost ground, there is no doubt that he would have easily won even without this incident of the race. That was a costly nose for the English gentleman, Mr. C. D. Rose. Instead of 266,625 francs, he had to content himself with the 10,000 allowed to the second, which is not precisely the same thing, without speaking of the satisfaction of self-esteem, which, for a man like Mr. Rose, represents at least as much.

We believe that we have never seen in the thirty years that we have witnessed the "Grand Prize" a more successful day in every respect, the only reserve to make applying to the horses, which might have been of a higher class. But the mundane point of view not being of our province, we prefer to remark that with a little vim and much money, intelligence and method, the races might become an excellent business. Ragostky, for example, whose sire Perplex and dam Czardas belong to Mr. de Schickler, who raised him on his Martinvast stud farm, is far from being a first-class horse. Well, adding to the cash of the Grand Prize of Paris the 138,000 francs of the Jockey Club Prize and the 49,000 of the Hocquart Prize that he won this year, we have the pretty total of 453,000 francs in three races and in two months!—*L'Illustration.*



RAGOSTKY, WINNER OF THE GRAND PRIZE OF PARIS.

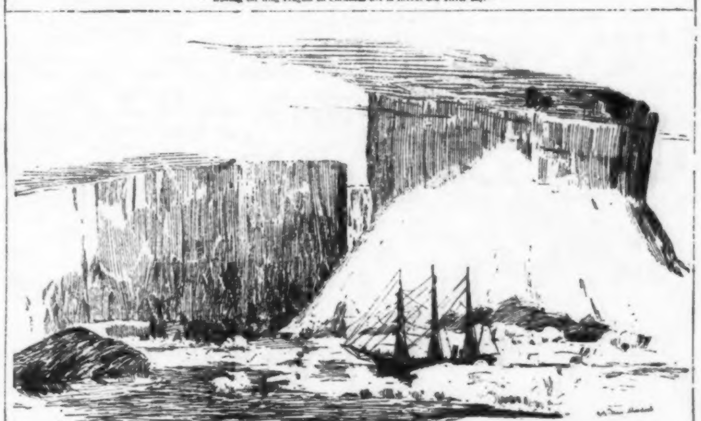
SOUTH POLAR WHALE AND SEAL FISHING.

THE Balæna, the largest of the four Dundee whale ships which sailed in September last for the Antarctic Sea to prosecute the whale and seal fishing, has arrived in Dundee Harbor. She is the first to return, and her arrival was watched with considerable interest. In a few words, the result of the expedition has been alike

success and failure. None of the real black whale was found, but seals in abundance of several varieties were easily obtained, and the Balæna returns with a full cargo of 5,000. The other ships to follow are also all reported full. The cargoes are profitable as well as large, the seal skins and oil are of great value, and the result will be a large margin to the good after paying expenses. A new field of enterprise and industry has thus been discovered, and the pioneer ships will not return alone next season. Scientific men accompanied the expedition, but the results of their observations will not be known for some time yet. It is strange that the fertility or otherwise of this remote region had never been determined before. For well nigh half a century the whalers of Dundee and Peterhead had talked it over, but as the fishing ground lay so far away, and as until recent years the Greenland seas had yielded a sufficiently remunerative harvest to the diminished fleets visiting these northern waters, nothing more than talk resulted. The last year or two, however, had proved so bad, both in regard to seals and whales, that what had at one time been a great and lucrative industry was threatened with practical extinction.

ANTARCTIC SEAL HUNTING.

Hunting the King Penguin on Christmas Eve in Erebus and Terror Bay.



Among the Icebergs in Latitude 64, S., Longitude, 55 W.

SOUTH POLAR WHALE AND SEAL HUNTING.

The Dundee whalers are familiar with the declarations of Sir James Clark Ross, R. N., who visited the Antarctic Seas from 1839 to 1843, and who reported that he found what he took to be the "real" whale in vast numbers in that region. He gave glowing accounts of the tameness of the prey and of the ease with which it could be captured. Seals were also, he said, to be found in abundance. As Sir James' statements had, however, never been corroborated—no one else having ventured into the silent and unknown region—it was not until Captain David Gray, of Peterhead, a few years ago called attention to the subject in a pamphlet, in which he urged the desirability of practical men making the long voyage of discovery, that serious attention was given to it. The advice of this most experienced of whaling masters, coming at a time when the industry was waning, led to resolutions being formed, and in September of last year four Dundee whalers—the Diana, Balæna, Active, and Polar Star—fully equipped, set sail for the sea of mystery. As to the incidents of the voyage, our artist correspondent sends the following notes:

We left Dundee on the 6th of September last in the Balæna, 250 tons register, a bark of Norwegian build, with an auxiliary screw of 65 horse power. Other three barks, rather smaller, followed a few days after. The Norwegian bark Jason met us in the ice four months later. The passage out, with head winds, took twenty days. Gales were met off the west of Ireland, and we had a bad time, loaded down to the deck with coal. After that we had light northeast trades and steamed through calms in the tropics. More gales were encountered in the "Forties," and we were five days at the Falkland Islands, where we were kindly received and got a "fresh meat" welcome. The smell of peat, too, a taste of the "mountain dew," and the general likeness of the islands to the Shetlands, made it all seem very homelike to us miserable creatures from the barren North. Darwin thought the Falklands, I believe, a dreary waste. The bird life there is astonishing—the waterfowl so like and at the same time so unlike our home birds. Fish is to be got *ad lib.* There is trout in any quantity, striped like the Canadian trout. As to the sea fish, so enormous are the quantities of it to be got that with a net across the lock mouth one could fill a fleet in a tide. It is a very varied matter from catching petrels on a tweed cast to a finner on a five-mile line and harpoon. We couldn't find the right whale, Balæna mysticetis, we went in search of, which, thanks to corsets, is worth from £2,000 to £3,000, inclusive of price of blubber. We followed Ross's track of 1842, and tried the neighborhood. Where, however, he saw right whales and finners (wrong whales) we only saw the latter. We killed, though, 5,000 unfortunate seals—shot them, and then skinned them.

There were four kinds of seals, one very large, averaging 12 ft. 4 in. long, with a head like a large Danish hound and greenish eyes and huge teeth.

One of my sketches represents boys killing a seal of this species with ice picks. A couple of Henry express bullets were, however, found the quickest way. It was very hard and unpleasant work, and lasted from nine to twelve hours a day in the boats. Our food during the cruise was beef! beef!! beef!!! biscuits, bad tea, and worse coffee. No grog—not on New Year's Day even. The first mate was Mr. Adams, son of Captain Adams, a famed Arctic whaler and explorer. He was a fine young sailor, and beloved by the crew.

The vessels which have been engaged in the fishing are much more strongly constructed and better equipped than those which were in vogue in the beginning of the present century. Then the fish of the Greenland seas did not penetrate so far into the ice as they do now, and fishing in the open was far less hazardous. Yet there were constant risks, and many hundreds of vessels lie below the Greenland waters. Indeed, there are few years even now in which one or other of the Scottish fleet is not left behind. The bows of the vessels are not less than 9 ft. thick, of wood, with iron plating. The sides are also of enormous strength. Fitted with steam they can not only resist the enormous pressure which large flows of ice sometimes inflict, but can drive into and through them with great force. They are all "fortified" to the last degree by the application of iron plates and timber to the exterior, and of a vast number of huge beams and stout stanchions to the interior. Vessels like these can live in any sea if it is open, and their chief danger lies in getting hemmed in and "nipped" by an ice formation, which, strong as they are, sometimes crushes their strong sides as if they were mere eggshells.—*London Daily Graphic.*

The Diana, Balæna, and Active sheltering behind an Iceberg during a southerly gale

SOUTH POLAR SEAL HUNTING.

INSECT RAVAGES.

ONE form of smuggling goes on the year round at this port, to the great detriment of the city, and without the slightest interference upon the part of the customs officers. This secret trade has been permitted ever since the city began to be a port of entry, and it goes on whether the administration be pledged to high protection or commissioned by the people to enforce against the protective principle the provisions of a long-neglected constitution. The articles thus smuggled come concealed in all sorts of merchandise, and so well concealed that they escape the eyes not only of the customs officers but even of the consignees. A tall, mild-faced, gray-bearded gentleman, often to be seen in the public parks and squares, knows more about this nefarious trade than any other man in the city, and although he would gladly suppress it, he is as powerless in this regard as the customs officers seem to be. He constantly encounters the contraband articles, however, and if you will go to the top floor of the Arsenal building in Central Park, he will show them to you by the bushel. Naturalist Dineen has a warm regard for this gentleman as a kindred spirit, for he is no other than Dr. Southwick, entomologist of the city parks.

Dr. Southwick knows all about the smuggling in question, because the smuggled articles vastly increase the labors of his office. He has found and identified by class and name more than 1,900 insects that prey upon the vegetation of the parks, and of these a great many are smuggled into the city through the Custom House. Every living vegetable product imported into this city brings with it some sort of noxious insect. Hundreds, thousands, and millions of such insects, in every stage of development from egg to moth, come in through the Custom House. They come with trees and plants, they come in the wood of packing boxes,

in mahogany logs, in rosewood, in pine, in all sorts of lumber, and in a hundred other imports. The consequence is that New York City has probably a greater variety of noxious insects than any other spot in the United States; and the woodlands of the urban parks have more enemies to contend with than almost any like area of natural wild forest in the world. As yet the imported pests have not spread much beyond the city limits, and even the great suburban parks are less multitudinously assailed than Central Park or other squares in the heart of the city. Naturalists all over the country write to Dr. Southwick, imploring that he send them specimens of the imported pests, and he does send scores and hundreds every year. There will soon be enough for every one elsewhere, however, for Dr. Southwick believes that the importation of insects into New York will result in such a spreading of the pests that before long every city that has parks or trees must have an entomologist or see its vegetation eaten.

When you realize that millions of fiendish little creatures variously armed with claw, tooth, nail, gimlet, saw, pincer, and every imaginable cutting, rasping and thrusting implement are busy day and night in destroying the vegetation of the parks, you must wonder that the city does not wake up some morning to find its pleasant green places reduced to leafless deserts. There are something like 180 enemies at work on the oaks, to say nothing of 250 on everything of the apple species, whether bearers of edible fruit or not, and a hundred or more that prey upon the elms. Dr. Southwick has up at the arsenal a little glass-covered box filled with baby caterpillars, enough, he says, if let alone, to destroy every leaf in Madison Square. It would be appalling to know that Dr. Southwick wages his unequal war with the aid of but two human assistants, if one did not also learn that he has been clever enough to turn the insects against themselves. It is the luckiest thing in the world that Dr. Southwick has taught his assistants to know at a glance the cocoon of a parasite insect, and the assistants would no more think of destroying one of those precious cocoons than they would of injuring a tree or a shrub. The parasitic insects feed upon the eggs of the insects that feed upon the leaves of plants. By the aid of these parasites millions of insect eggs are destroyed.

Dr. Southwick desires also to acknowledge with gratitude the aid of sundry birds, especially the thrushes and the warblers. The latter are beautiful little creatures of many varieties. Some are next to the humming bird in size, and they are just made to be the enemies of noxious insects. You may see the climbing warblers almost any day going round and round the trunks of trees in defiance of gravity and the prosecution of duty. They destroy untold millions of insect eggs every year, and Dr. Southwick would like to see the warblers multiplied by the tens of thousands. As to the sparrows, he would gladly see them destroyed, as they not only do not attack his insect enemies, but actually keep away birds that are truly insectivorous. One warbler is of more value than many sparrows.

One of the most annoying importations of recent times is the elm borer. He was smuggled in from Germany about seven years ago, and he is now distinguished for pernicious activity, not only upon the elm, but upon several other trees. The elm borer comes from an egg laid by a moth in the bud of the elm. When the little worm develops, he eats his way into and through the small twig to which the bud is attached, thence to the branch, and thence slowly bores away until the time comes for him to descend to the ground. To accomplish this he channels his way around the limb and waits until the wind breaks it off, and once on the ground he develops into a moth. This moth lays eggs, with its great ovipositor, in the buds, and the evil round is rebegun. Limbs several inches in diameter are cut off by the elm borer, and hundreds of trees have suffered from his ravages.

The elm suffers most of all from the elm beetle, which eats up the leaves. Dr. Southwick fights this pest with a sort of engine, mounted on wheels. It consists of a reservoir of spraying material and a force pump. A hose is attached to the pump, and if need be, one of the doctor's assistants climbs the tree, carrying with him a long bamboo fishing rod. The nozzle end of the hose is attached to the rod, and the man in the tree is able to reach out twenty-five feet from his standing place and spray the highest and longest branches. Dr. Southwick has done wonders for the elm in this fashion, and has answered thousands of letters upon the subject, as lovers of the elm all over New England are alarmed at the work of the pest. Dr. Southwick treated 22,000 of the public elms last year with the spray of London purple mixed with flour.

The ailanthus is one of the luckiest of trees, as it has only four or five enemies, among them a silkworm from the cocoon of which the people of China spin silk. Even the evergreens are attacked, and the cotton scales on the pines contain millions of lice that settle down thus for life and suck the sap as it flows. Much the same thing is true of scale insects on many other trees. To the eye of the ordinary observer these pests seem like a slight irregularity of the bark, and would never be suspected of sapping the life of the tree.

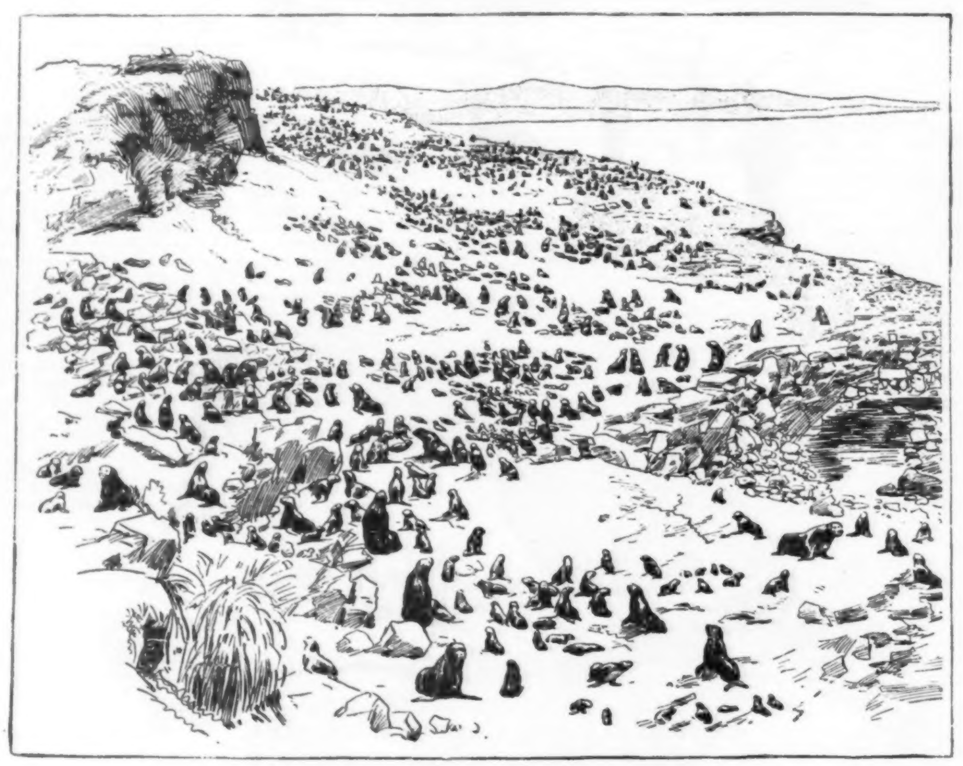
Dr. Southwick and his men never quit their work winter or summer, and they have just finished housecleaning, so to speak, in the down-town parks, though Washington Square they had to leave almost unattended to because there was so much work elsewhere. Winter is a good time to fight the insect pests, because it is possible then to get an unobstructed view of the trees and destroy eggs by the million. Thirteen bushels of cocoons were picked off a few thousand trees last winter, and as each cocoon produces about 240 caterpillar eggs, the destruction was of considerable value. It is a mistake, however, to suppose that the severity of the winter materially lessens the number of insects the following summer. Dr. Southwick expects no relief this summer because of last winter's low temperature. The insect eggs are laid up with much care, and many of them seem to be uninjured by freezing. It is possible to keep the butterfly's eggs for three years at a temperature below freezing without destroying their speck of life. Any temperate or sub-tropical insect comes well enough through the winter of this region, and as to the tropical creatures, they are seldom seen here save in the greenhouses, where they prey upon the vegetation to which they belong.

Dr. Southwick cultivates his enemies with great assiduity in order the better to understand their ways and the more easily to circumvent and destroy them. He has a number of little hatcheries in his interesting attic, and here you may see in all stages of development a great many of the 1,900 evil spirits that haunt the park. In the course of his work Dr. Southwick comes upon many curious and interesting things. He has discovered and named many new insects hitherto unknown to science. To be an entomologist with the freedom of the parks is almost as good as to take a journey abroad in search of specimens. Other entomologists go forth to strange places to hunt insects, while foreign insects come to New York seemingly in search of their keenest enemy. Rare and beautiful moths, known only to the collectors, abound among the 1,900 varieties of the parks, and the field of study is inexhaustible to any one human being, because to know the habits and history of a single insect may require years of observation.

Dr. Southwick has been studying one of his insect acquaintances for five years. The doctor takes a two weeks' vacation and gives much of it to this old friend. This fellow is the parsnip web worm, a most curiously conducted creature that eats his way along the whole stalk of the wild parsnip and sometimes ravages whole fields of cultivated parsnips. He loafs from August until the following June, or at any rate he is not occupied with the parsnip during that time. His movements are mysterious, and Dr. Southwick after all these years of study feels that their acquaintance is as yet of the slightest kind.—*N. Y. Sun.*

A SEAL ROOKERY IN THE BEHRING SEA.

THE principal breeding places of the fur seal of the North Pacific, whose manners and customs are just now the subject of solemn investigation by an International Tribunal in Paris, are the Pribyloff and Com-



SEAL ROOKERY, ST. PAUL ISLAND, ALASKA.

mander Islands. The accompanying illustration represents a seal rookery in St. Paul Island—the largest and most important of the Pribyloff group. St. Paul is thirteen miles long, with a maximum width of six miles and an area of about forty-two square miles. When it was discovered by Pribyloff in 1786 it was entirely uninhabited by man. The dominant population consisted of fur seals, who lived a life of Arcadian simplicity until disturbed by an alien immigration of human beings.

Notwithstanding this change, the seals have continued to haunt St. Paul and the other islands of the group. Their breeding rookeries and hunting grounds—the latter being tracts which the bachelors and other seals not actually engaged in breeding frequent—are confined to the immediate vicinity of the coast line. On St. Paul Island are at the present time seven recognized breeding rookeries called respectively the Zapadine, the Tolstoi, the Lagoon, the Reef, the Ketavie, the Palavina, and the Northeast Point. Our illustration represents a portion of the Ketavie rookery sloping eastward. This rookery is in parts much broken by the irregular jutting out of the solid rock and the many angular masses which have detached themselves from it. This arrangement, to all appearance very comfortless, suits the peculiar tastes of the fur seal, and the Ketavie rookery has been the cradle of many generations of this amiable amphibian.—*Daily Graphic.*

THE INDIAN OCEAN.

By RICHARD BEYNON.

THE aggressive superiority of the western nations of Europe was never so fully demonstrated as during the later decades of the fifteenth century. Then the stay-at-home residents of America, Africa and Asia were *discovered* by their more enterprising brethren from our own continent. Portugal's share in the achievements of exploration was by no means an inconsiderable one. By 1484 they had mapped out the west coast of Africa almost to the tropic of Capricorn, and, in 1486, Bartholomew Diaz doubled the southwestern extremity of that continent. Cabo Tormentoso he styled the point, but his sovereign, wisely recognizing the possibilities which such a feat opened up, very aptly denominated the headland Cabo de Boa Esperanza, the Cape of Good Hope. The ocean course to the Cape made good, it only remained to demonstrate the extension of the route right to the shores of India. This was accomplished by Vasco da Gama in the spring of 1498, who, leaving the Tagus in the previous autumn, doubled the Cape, successfully navigated the Indian Ocean, and arrived at Calicut on the Malabar coast. Viewed in the light of subsequent developments it is somewhat amusing to learn that Portugal's ruler was, on the strength of this voyage, invested by the Pope with the proud and comprehensive title of "Lord of the Navigation, Conquests and Trade of Ethiopia, Arabia, Persia and India." The claim, however, was not undisputed, and the energy with which the commerce of the East was exploited did much even then to gain information respecting the ocean to which India has given its name.

On the north, east and west the inclosing lands of Asia, Australia and Africa mark the present limits of the Indian Ocean. Its ancient boundaries, which no doubt obtained at no very remote geological period, were the highlands of Eastern Africa, the Himalayas, and the raised land mass which runs through the length of the Eastern Archipelago. On the south, the commonly assigned limit of this ocean is the 38th parallel. This is no arbitrary line of demarkation, for from the ocean-bed there rises along this line a submarine bank which, with its ramifications, practically forms the southern edge of the depression and supplies a foundation platform for the islands of St. Paul's, Amsterdam, the Crozets and the Kerguelen group, etc. Soundings taken over the Indian Ocean show that over 50,000 square miles of its bed lie at a greater depth than 3,000 fathoms, while no less than 13,000,000 of square miles are between two and three thousand fathoms from the surface. The average depth along a line of soundings extending from Java to Australia is 3,000 fathoms. Along the southern boundary the mean depth is but one-half of this. Surrounding Madagascar is a shoal patch, which, on the east of the island, rapidly falls into the main basin of the Indian Ocean. In the Arabian Sea, the declivity from the shore-shallows is much more gradual. Much of the Bay of Bengal is over 2,000 fathoms in depth, while the mean depression of its eastern section is much less than the depth of the western portion. Both the Andaman and Nicobar groups rise from a shallow platform extending from the Irawady to Sumatra. As might be expected, much Antarctic water finds its way over the bank which forms the only barrier between the South Polar and Indian Oceans. In all the deeper portions of this essentially tropical ocean, water of a temperature of 32° Fah. can be obtained, no matter how heated the surface water may be. A line of soundings between Aden and Bombay showed a mean depth of 1,800 fathoms, a surface temperature of 75°, while the deep sea thermometer showed 36½° Fah.

The sea-bed of the Indian Ocean follows the general law of oceanic temperature and is traversed by a slowly moving set of polar water, but the surface shows mean temperature far higher, taking latitude for latitude, than anything experienced in the Atlantic and Pacific. The explanation of this is not far to seek. On all sides save the south there are inclosing masses of land, the greater portion of which lies within the tropics. In the Atlantic and Pacific too, the superheated water of the equatorial current can escape either to the north or to the south. In the ocean under discussion it can only escape southward. Thus, if we take that section lying between the tropics, the thermometric mean is 75°. Along the equator the average temperature is 80°. The line of maximum heat is not identical, however, with the central parallel of latitude, the thermal equator shifting its position with

the sun, being north of the geographical equator during the northern summer and south of it in winter. In the Arabian Sea the average maximum temperature of the surface water is 87°, and this has been exceeded on several occasions by three degrees. Along the 38th parallel the thermometric seasonal change is comparatively slight, the range lying between 70°, which is the January mean, and 60°, which is that for the mid-winter month. The land masses not only tend to increase the temperature of the waters of this ocean by preventing their egress toward the north, they also interfere with ocean level. For this piling of the waters upon the northern shores of the ocean the monsoons are, of course, in part responsible. Thus, during a geodetical survey of India, the sea level at the Indus mouth was found to be no less than 515 feet higher than the ocean surface at Cape Comorin.

One of the most interesting features connected with the Indian Ocean is the peculiar characteristics presented by its offset, the Red Sea. As to why it is called *red* opinions widely differ. According to some it is the reddish color of the inclosing shores in certain localities that is responsible; others assert that occasionally the presence of microscopic organisms near the surface give the water a sanguinary tinge; by some, vegetable matter is put down as the coloring agent; while the theory that in some far-away period of history the waters of this sea reflected a coppery sky, and hence a casual observer styled it the Red Sea, does not want supporters. Corals also figure among the list of causatives. An ancient traveler shrewdly remarks: "The Rede Sea is not more rede than any other sea, but in some places the gravelle is rede, and therefore men style it the Rede Sea." Whatever local circumstance may have given rise to the name the sea is about as aptly named as the Pacific Ocean, the Vermilion Sea and the Yellow Sea are. Navigators know that whatever may be the hue of the waters in particular patches, the deep water of the Red Sea is of a deep blue color.

No river pours its tributary waters into this land-locked basin, and the rainfall precipitated upon its surface is so small that it need hardly be reckoned with in assessing the sources from which the sea draws the waters necessary to replace those used in evaporation and outflow. With a length of 1,400 miles, a maximum breadth of 200 and a mean width much less than this, the Red Sea is inclosed by what is literally a burning strand. Down its center runs a canal of deeper water, which recedes to its lowest recess about the middle of the sea. Much of this canal is removed 1,200 fathoms from the surface, but the average depth of the whole sea is considerably less, being 375 fathoms. The ridge which runs across the Strait of Bab-el-Mandeb, or the Gate of Tears, as the Arabs have styled it on account of its fertility in producing maritime disasters, has upon it a maximum depth of 200 fathoms. Over it flow two superposed currents of water. The underneath one consists of the dense and salt water escaping from the Red Sea, while the surface flow is the fresher water from the Indian Ocean, which seeks to restore equilibrium. The density of Red Sea water is 1·03 when compared with distilled water; that of the average ocean is 1·026. The percentage of dissolved matter is in excess of 4, being one-half more than that contained in ordinary sea water. It has been estimated that if the connecting link with the Indian Ocean were closed, a space of 2,000 years would be sufficient to evaporate all the Red Sea water, and leave the matter at present in solution a crystallized mass in its bed. The copious evaporation that goes on may perhaps best be seen from the temperatures that obtain. It is very rarely that any portion of the Red Sea water shows a lower temperature than 70° Fah., except in the northern portion during the winter. Even in the depths the constant reading of 71° is obtained. In fact, this temperature is registered whenever a thermometer is sunk to a depth of 200 fathoms. Above this, the water follows the seasonal changes; below it is 71°, no matter what the time of the year, the depth, or the geographical position of the spot selected. In the northern section the mean temperature of the surface water lies between the winter and summer averages of 66° to 79° Fah. In the middle portion the range is from 75° to 86°, while in the southern section it is practically between 80° and 90°. Although the temperature of the surface water shows a considerable seasonal variation, the diurnal range is practically *nil*. This is not so, however, with the atmosphere superincumbent to the Red Sea and its shores. When the sun sets intense radiation goes on, and the unbearable heat of the day is succeeded by great cold. In fact, Jacob's description of Padan Aram applies most aptly to the Red Sea littoral: "In the day the drought consumed me and the frost by night." In the shade on a vessel's deck the thermometer may show 105°, while the temperature of the atmosphere above the adjacent shore may fall at night to 40°, or even below the freezing point. It not infrequently happens in the southern section of the sea that the air above the surface is cooler than the water even at mid-day. Thus on four successive days the surface water showed 100°, 106°, 101°, 96°, while the overlying air was 80°, 82°, 88°, 82°. Two causes assist to bring this about. The first is the dryness of the layers of air superincumbent to the Red Sea surface and its environs. The sun's rays penetrate these without losing much of their heat, the air being heated, not by the direct passage of his rays, but by radiation of the heat waves from the superheated water. The other cause is to be found in the character of the prevailing winds. These, during seven or eight months of the year, blow mainly from the north to the south, reversing their direction for the remaining four or five months. Thus the prevalent breezes blow in the direction of the sea's greatest length, a fact which, besides moderating the aerial temperature, also plays an important part in Egyptian agricultural economics. The vast swarms of locusts that devastate the wadys of Arabia would be enabled, by means of an easterly sequence of winds, to migrate westward and transfer their ravages to the more fertile stretches of Egypt and the adjacent territories. The winds, however, prevent this, and the Nile valley is thus spared the destructive visitations of these predatory pests.

The current system of the Indian Ocean somewhat resembles that of the North Atlantic or the North Pacific. There is a well-defined equatorial drift entering through the network of islands that constitute the Eastern Archipelago. Variations are, however, produced by the monsoons. Still the westerly set of the current is aided by the trades. The equatorial drift after leaving Malacca Straits has an estimated velocity of 30 miles per day; along the southeast coast of India its rate is 24 miles per day. The main section of the stream sweeps past the coast of Ceylon with a velocity of 40 miles a day. In the Arabian Sea, that portion of the equatorial current that makes the tour of those waters travels along the coast of Arabia at a reduced velocity of 18 miles per day. During the prevalence of the southwest monsoon a portion of the current system of the Indian Ocean is deflected toward the Malacca Strait and moves at the rate of about one mile per hour.

The feature, however, of the current system is the Natal or Mozambique current. This ocean river is the Gulf Stream of the Indian Ocean. When passing Cape Corrientes its speed is 80 miles per day, and at times it even attains a velocity of 130 miles a day. This high speed gradually diminishes until off the Cape it has fallen to 50 miles. Here it is known as the Agulhas current. Its meeting here with the inset from the Antarctic Ocean is paralleled in the North Atlantic by the meeting of the Gulf Stream with the drift from Baffin's Bay and Davis Strait off Newfoundland.

The bringing into close juxtaposition of two air masses of such unequal temperatures produces numerous fogs, which, however, do not rival in intensity and frequency those experienced off the Banks. The effect of this current upon the climate of Cape Colony must be considerable, for when at its strongest it carries a temperature of 79° Fah. as far west as 15° east longitude. The meeting of the waters off the Cape causes a bifurcation of this splendid current, one section proceeding along the African shores of the Atlantic, while the other is deflected as a drift moving at the rate of 20 miles per day toward the Australian coast.—*Nautical Magazine.*

EXTINCT VOLCANOES IN THE UNITED STATES.

By RALPH S. TARR.

THE living volcanoes in the territory of the United States are very limited in number, and when we exclude those in Alaska, this country may be said to be non-volcanic at present. Yet this is but a temporary condition, one which we have only recently attained, and which may at any time be interrupted by volcanic outbursts. A chain of volcanoes extends from southern South America into Mexico; then there is a large space in which there are no volcanoes, and the interrupted chain begins again in Alaska, curves southward and joins the chain which exists in Japan. This intermediate non-volcanic region has just emerged from an era of volcanic activity of a most stupendous nature.

When the early settlers in Italy reached the vicinity of Naples they saw across the bay a conical mountain of volcanic form, but which gave them no reason to believe it an active volcano. The sleeping fires of Vesuvius had been dormant for years, and it was not long before its flanks were covered with vineyards and dotted with villages and towns. This condition prevailed until just before the Christian era, when ominous rumblings foretold an approaching calamity of which the inhabitants were apparently ignorant. In the year 79 a terrific eruption occurred which overwhelmed the inhabitants and buried the farms and towns beneath a bed of volcanic ash. The volcano had awakened with an eruption which has never since been equaled in Vesuvius. Pompeii and Herculaneum were destroyed and buried, and it appears from the records of the time that even the great naturalist, Pliny, was not aware that a volcanic eruption had occurred, but met his death in his endeavor to discover the cause of the noises, showers of ashes and consequent darkness. We have volcanic mountains in the West which are perhaps no more dormant than was Vesuvius, and although it may never happen, we may yet have violent eruptions in this region.

Active volcanoes are associated in greatest numbers with mountains which are still growing; and it is also a notable fact that they are, with few exceptions, either in or near the sea. The various theories offered to explain this need not be given. A theory which seems to explain most of the facts is, briefly stated, that there is at a certain depth beneath the surface heated rock which, if the pressure is relieved, will escape to the surface provided a vent can be formed. In mountains the rocks are folding, and consequently arches are formed beneath the folds which allow the lava a chance to expand, and the pressure is often sufficient to rupture the rocks and form a vent to the surface. This is sometimes aided by a breaking or faulting of the rocks which occurs in all growing mountains. Such a brief statement as this cannot take into account the objections to this theory, but it is offered as the one which seems best to account for the greater number of facts. It may be said, in addition, that the explosive agent is always steam which is inclosed in the melted rock.

There is a chain of mountains, practically continuous, though not strictly so, and made up of many ranges, from Patagonia to Alaska. In South America, and apparently also in Alaska, these mountains are still growing. On several occasions within the last two centuries, the land on the west coast of South America has been elevated during one of the numerous earthquakes. On the seashore we have a good bench mark for registering such changes, and in Chile the land has risen, within historic times, to a height of several feet. How much higher the Andes have grown in the same time cannot be told, for we have no datum plane for comparison; but it may be stated, without fear of exaggeration, that they have risen much more than the coast, for it is the mountains which are growing.

In the United States the Western mountains seem to have nearly, if not quite, ceased growing, but this is only recently achieved. The Sierra Nevadas were the first to be formed in the early Mesozoic times (Jura-Trias), shortly after the close of the Carboniferous period. Since then they have been added to, probably during the growth of the other mountains of the West. Of these, the Rockies were the first to be formed, having been begun in Cretaceous or early Tertiary times, and only recently finished. The Coast Range mountains were last formed, and it is probable that neither of these last two ranges has entirely ceased growing.

From the beginning of the growth of the Sierras down to the present there has been in this region of the Cordilleras practically one continuous period of volcanic activity, and the history of this time has been both complex and interesting, as well as important to the country. The history of the volcanic action during the formation of the Sierras is more obscure than that of the other ranges, because it is more ancient and the pages of the history have been mutilated or destroyed by the forces of weathering and erosion which have been in operation since then, destroying and removing the rocks. Granites and many other rocks intruded into the earth and forced out upon the surface may be still seen in these mountains, but the actual volcanoes of that period are destroyed.

The early volcanoes of the Rocky Mountains have also been destroyed, but their roots still exist, and many of the hills rising sharply above the plateau and forming "buttes" are no more than volcanic necks or plugs—the volcanic vent which, when the volcano ceased eruption, became filled with hard solidified lava. In New Mexico, Arizona, and other parts of the Rocky Mountains these are by no means rare, and they now stand up above the plain like grim sentinels, ghosts of departed volcanic energy. Traversing the beds of sandstone, limestone and other strata are dikes of lava which in some cases are the feeders of volcanoes, in others the offshoots from some volcanic vent, indicating an effort on the part of the lava to reach the surface by some new channel.

It is, however, the more recent volcanoes which have the most interest. Some, like Mount Shasta, have been dormant for so short a time that their conical form is still preserved, and in all but actual eruption they are true volcanoes. Perhaps they may be only dormant, but probably they are forever quiet. Then, too, one finds in various parts of the West small cones with small lava flows extending from them, and all looking so young that, for all we can see to the contrary, they have been erupted only a century ago. These recent lava flows may be seen in the Canyon of the Colorado, in the deserts of Nevada and Utah, and in New Mexico.

The author has in mind one in the latter Territory, on the government road from Carthage to Fort Stanton, on the Mescalera Apache Indian reservation, which is so recent in appearance that it cannot be told from some of the lavas which a few years ago were sent out from Kilauea in the Hawaiian Islands. This flow stretches nearly north and south for many miles, and when seen from the mountains at a distance of ten or fifteen miles, it is a great line of black in the brown desert plain. When approached more closely, it is found to be a bristling mass of black lava blocks, so rugged that even the antelope cannot cross it. Finally the road, which is turned to one side by this obstruction, finds a narrow place where the lava is less broken and turns across it. No soil has been formed since the lava flowed out, and the basalt rings beneath the wheels of the wagon. As one looks over the lava it seems impossible that many days have elapsed since it was poured out, but upon looking more closely a few shrubs are found growing here and there in favorable places, which proves that the lava is not a product of a few months ago. It cannot be many hundred years old and I believe it was erupted since the white man discovered this continent.

Such lavas as these, small in extent, and marking usually one or at most a very few eruptions, were apparently the dying throes of the great volcanic giant which convulsed this region in late Tertiary times. The region was literally flooded with lava and in recent times the only parallel is found in the great basalt flows of the Deccan, in Asia. So great are these floods that the students of the geology of this region have almost unanimously concluded that some of them did not come from volcanoes, but from great rents in the strata. An immense plateau in the Snake River Valley in Idaho has been built out of lava which flooded and partly filled the great valley for hundreds of square miles. The plateaus of New Mexico are in large part capped by lava flows some of which undoubtedly came from the volcanic cones that still rise above the plain, although so nearly destroyed that they do not at first seem to be volcanoes. Other flows seem to have come from fissures. In the valley of the Columbia the same thing is shown, and indeed throughout the Cordilleras great Tertiary lava flows prevail.

One of the most interesting facts connected with these great flows of lava is the association between them and the gold-bearing gravels of California. Here in the geological age immediately preceding the present (the Tertiary) well developed rivers flowed out from the Sierras upon the plains at their western base. When the Coast Range was being formed great volcanic eruptions occurred and the flows of lava naturally sought the river valleys as the easiest path of flow. The rivers which occupied them were then forced out of their valleys and caused to carve new channels. This they did, usually, upon one side of the old valleys, and now, owing to the protecting effect of the hard lava, the ancient river gravels are found in hills with a lava capping. It is from these gravels that much of the gold of California has been extracted, and to the lava flows we owe, in large measure, these stores; for, had the gravels not been protected, most of this gold would have been swept into the sea. In one of these auriferous gravel deposits, the famous Table Mountain, in Tuolumne County, implements of man have been found, beneath a thick flow of lava, showing that man was a contemporary of this period of lava eruption.

Between the Rocky Mountains and the Appalachians relics of volcanic eruption are extremely rare. Aside from certain igneous rocks in central Texas, near Austin, and in Indian Territory and Arkansas, practically all of the volcanic activity has been of an age preceding the time of formation of the earliest stratified rocks. This area has been remarkably free from volcanic action, as, indeed, from the formation of mountains. It is essentially a region of plains, and such a region is rarely disturbed by volcanic activity, unless mountains begin to grow there.

The Appalachians also have been strikingly free

from volcanoes, although, in the older mountains to the east of these, signs of volcanic activity are not absent. Still, since Triassic times, that is since the Sierra Nevadas were begun, there have been no volcanoes east of the Mississippi. During the earliest age of the earth's history, the Archean, New England and the seaboard States south of this region were disturbed by volcanic action. Again, in Paleozoic times, perhaps during the formation of the Appalachians, the same region was visited by volcanic disturbances, and during these periods the granites were intruded into the rocks and lavas sent out to the surface. Rocks of both these characters may still be seen in the vicinity of Boston.

A third and final great period of volcanic activity was developed in the Triassic period accompanying or immediately preceding a regrowth of the Appalachians and a faulting and folding of the rocks in a part of this region. These lavas were all black trap rock of remarkably uniform character from the Carolinas to Nova Scotia. On Cape Ann, in Massachusetts, there are hundreds of dikes of this lava cutting the granite, and the same is true of all the coast area in the region occupied by the volcanoes. These were either feeders of volcanoes or offshoots from feeders. The greater flows and intrusions of this rock may be seen in the Palisades of the Hudson; the trap hills of New Jersey, near Paterson, Orange, and other places; East and West rock of New Haven; the Hanging Hills, near Meriden, Conn.; Mount Holyoke, in Massachusetts; and elsewhere.

Thus a country which is now but little disturbed by volcanic eruptions has been, like most equally large regions in the world, the witness of numerous periods of activity during the past geological ages. The architecture of the continent has, as an essential part of its structure, numerous and various igneous rocks, and we are now profiting by their presence and the influence which they have exerted upon the rocks and minerals of the country. Not only are they an important element in the scenery of the country, but also they have exerted an essential influence upon the mineral wealth. All volcanic rocks carry metals in a very disseminated condition. By processes which cannot be described here these have been gathered together into mineral veins, and the greater part of our mineral wealth is either primarily or indirectly derived from this source. Therefore, where volcanic rocks are abundant there also we find the greatest abundance of ores. While this is the essential feature for the origin of metalliferous deposits, there are also other causes which aid in their accumulation, and the formation of mineral veins is not as simple as one might suppose from this general statement. But to volcanic activity, of one period or another, we owe not only the granite which we use in building, but many of the metals which are used in the arts; and it may be safely stated that had this country been free from such activity, our metallic wealth would have been very limited. In the central States, where volcanoes have been practically absent, the production of metals is unimportant; in the Eastern States, chiefly because of the absence of recent volcanoes, the product of metals (barring iron, which is present everywhere in the rocks), while more important than in the Central States, is still far less important than that of the Cordilleras, where the strata are crossed by and bedded with a maze of volcanic rocks of all ages and kinds. In the non-volcanic regions the metals which do exist would, no doubt, be found to have originated in igneous rocks, if their history could be traced. A part of our store of metallic wealth came, no doubt, from the original crust, but this original supply has been decidedly added to by the addition of fresh stores from the regions beneath the crust.

ANCIENT GLACIAL MORAINE AND DRIFT AT THE MOUTH OF THE COLUMBIA RIVER.

By W. HAMPTON SMITH.

A GEOLOGICAL formation of more than ordinary interest exists on the north bank of the Columbia River, near its mouth, and directly opposite the city of Astoria, at what is known as Chinook Point, in the form of an ancient glacial moraine. By ancient I mean many thousands of centuries before our last glacial period. The Columbia River at its mouth forms an extensive estuary reaching about 40 miles into the interior, and varying from 4 to 10 miles in width.

At the point in question it is 4 miles wide and about 6 miles from the open sea. At the western extremity of the section under discussion the hills rise abruptly about 1,200 ft. and extend eastwardly along the river at about the same average height for about 5 miles, with perpendicular cliffs at many places of a hundred feet or more in height. The extreme western end of this range of hills is called Scarborough Hill, after Captain Scarborough, who settled here some 50 years ago. This hill is of volcanic origin, the rock being compact and more resembling diorite than anything else I know of. To the eastward of this eminence the hills are composed of gray sandstone and shale, some 800 or 900 feet in thickness. The sandstone is compact and massive, much of it very hard, and so far as I have been able to determine destitute of fossils. The strata have a slight southeasterly dip, and I think belong to the cretaceous era. On top of this, and further to the east, reposes a fine hard blue shale. On top of this again, and still further to the east, rests a more recent, friable shale approaching morlite.

The sandstone disappears under these shales, which seem to be hundreds of feet in thickness, and on the south or Oregon side of the river, the friable shales only appear.

Now come the interesting part of my story. Beneath this stupendous pile of sandstone and shale lies for more than 2 miles in length, and from 30 to 50 ft. in thickness, a mass of glacial debris so ancient that it has become metamorphosed by heat or other agencies, so that it is a solid, compact rock, having all the structural form of moraine and loess so common to our modern glacial phenomena. It is not gravel conglomerate, so often seen in different portions of the globe, but earthy matter filled with fragmentary rocks and bowlders, some of which are 8 ft. in length by 5½ in width, and 4 ft. thick.

In some portions of this wonderful formation these bowlders are very numerous, ranging from 1 foot up to 6 and 8 ft., and of quite a variety of rock. Some are sandstones, some are finely laminated argillaceous shales, one of the latter being 6 ft. in diameter, but for the most part they are of some form of trap rock. The larger bowlders are nearly all rounded, more or less. One or two I noticed were square and angular. I found no quartzite in any instance, such as is so frequently mixed with our Western glacial debris. I found a few small cement bowlders. All intermixed with these larger stones are smaller ones, down to earthy matter, but in no instance did I find sand forming the filling between the coarser debris,

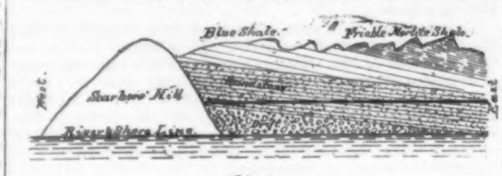


Fig. 1.

such as would naturally be the case were this the work of the waves, disintegrating a rocky cliff on a subsiding coast.

The portion of this ancient glacial deposit containing the larger bowlders does not extend over about 300 yards up and down the river along the bluff.

A mile farther to the west in the cliff they are very numerous, but not so dense.

On either side of this bowlder formation for a considerable distance is a thick deposit of what appears to be a metamorphosed bed of loess or glacial earth. It presents in some places an exposure of 25 or 30 ft. perpendicular height, and is to all intents and purposes stone granulated and somewhat easily decomposed by the weather and waves.

It contains small fragments of stone of various kinds sparingly. I am forcibly reminded by the character and relative position of these formations of our modern moraines and finer glacial debris that are nearly everywhere present in this great Northwest.

I imagine that, if a high degree of heat combined with pressure were brought to bear on our modern drift of like quality and position, it would present the

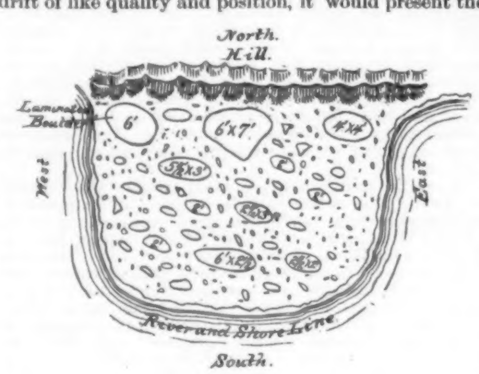


Fig. 2.

same appearance, varied only by the character of the material. Through the metamorphosed loess drift there is a basaltic dike protruding. This dike on one side of a point extending into the river is 4½ ft. wide and on the other side of the same point, 150 ft. distant, it is 4 ft wide, with walls on either side of the dike as clear cut and true as if it had been done by a carpenter and joiner. It is nearly vertical and the walls on either side do not show any signs of fusion, even where there is an immediate contact. Twelve or fifteen inches from either side of the dike toward the center is a very hard compact basalt, with the columnar structure horizontal from either side, the columns being small. About 18 in. of the center is divided into vertical bends of about 3 in., separated partially by porous seams. These seams and the center of the dike contain crystals of feldspar, giving it the appearance of diorite. This would indicate that the presence of crystals of feldspar was due more to a thermal condition of the outflow than to its place of origin.

There are no signs of any flow of lava along the shores coming from this vent hole. The whole shore line has been eroded off, some places leaving perpen-

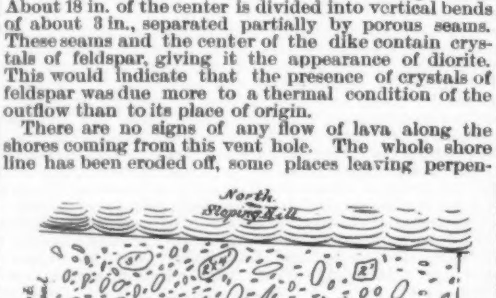


Fig. 3.

dicular cliffs 100 ft. high, by the great modern Columbia River glacier, that poured into the sea at this place.

I consider this a most remarkable formation. The sandstone overlying this drift lies squarely upon it, and is apparently 800 ft. or more in thickness.

There is no trap rock resembling this that I know of, within many miles of this location. The formation at Scarborough Hill is widely different from this wreckage. Some twenty miles up the Columbia River are vast quantities of columnar basalt, but it is of much more recent date than the formation in question, and of decidedly a different type. I stand and look upon these huge bowlders buried beneath a mountain of sedimentary rock—old and gray with the centuries that have passed into eternity—with a sense of bewilderment.

It overturns some of my most cherished theories in reference to the scope of glacial phenomena. I have always contended that there was but one glacial catastrophe, and, if it be true that this formation is true glacial, it shows that the earth in its comparative youth has been subjected to desolation and death, commonly ascribed to old age, and that it has probably been populated and depopulated many times during its long unwritten history.

Everything associated with this strange deposit seems to point to a glacial origin, and yet, in spite of this, I am forced into a state of skepticism, because it

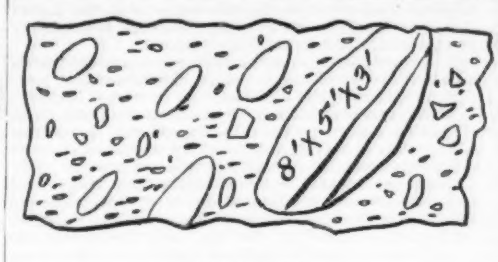


Fig. 4.

seems to stand across the path of other great natural laws, by which this earth is controlled. May it not be the wreckage from a cliff forming the center of this range of hills on a subsiding coast? But, if so, how does it come that the band of fine debris is not sand, instead of earthy matter, as we see in all like wreckage on subsiding coasts at this day?

I have given as faithful an account of this formation as a casual study of it will admit. I send hasty pencil sketches of the location and different portions of the deposit, which will convey a limited idea of the nature of it.

Fig. 1 is a diagram of the various phases of the locality under discussion and is a vertical section. The spectator is facing north and the view covers about 3 miles. For a greater part of the distance to a point indicated by the heavy black line is a perpendicular bluff near a hundred feet high. The bowlders protrude from the face of the cliff. The exposure of the drift for much of the distance is 40 to 50 ft. in height.

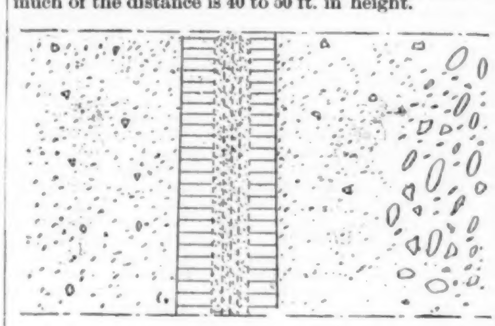


Fig. 5

The face of the sandstone above is about the same number of feet, when the hill recedes, with great ribs of rock exposed till the summit is reached, some 900 ft. high. Further up the river, the sand rock disappears beneath the water, when nothing but shale is visible.

Fig. 2 is a horizontal section that has been eroded on top by the storm waves, leaving an exposure of a surface 100 × 50 ft. The beholder is looking down on the drift. The circles are the bowlders with their dimensions in feet. The balance is a conglomeration of all sizes and varieties of debris.

Fig. 3 is a vertical section about 50 ft. to the east of Fig. 2, and is 75 or 100 ft. in length and about 30 ft. in perpendicular height. It is in a cove made by the waves, which in a storm beat with great fury on this shore, carving it into little bays, inlets and grottoes of the most pleasing and picturesque form.

As before, the large circles are the bowlders, with their dimensions marked in feet. It is really a continuation of Fig. 2 to the east, only vertical.

Fig. 4 represents a large fragment that has fallen from the cliff, where it has been undermined by the waves. It is about 18 × 10 × 5 ft., and is composed of bowlders and other wreckage. The large bowlder has several large cracks in it, as indeed many others seem to have, caused apparently by heat. This fragment has fallen from Fig. 3.

Fig. 5 is a basaltic dike, some 4½ ft. wide, protruding through what I call metamorphosed loess or glacial soil. It is banded in the center with vertical porous lines some 3 in. apart, containing crystals of feldspar. The central third contains feldspar crystals. The outer two thirds is plain basalt. The metamorphosed loess appears on either side graduating into regular morainic bowlders on the right.

Astoria, Oregon, July 10, 1893.

FOGS, CLOUDS AND LIGHTNING.

MR. SHELFORD BIDWELL, M.A., F.R.S., in a recent lecture at the Royal Institution on the above subject, began by speaking of the popular idea that what is seen coming from the chimney of the locomotive or the spout of the tea-kettle is steam, whereas it is cloud, and steam is invisible. Nevertheless, he thought that scientific men had acted in a high-handed manner by taking an old word and attaching to it a new meaning of their own; as Humpty Dumpty said to Alice, "It is a question which is to be master, that's all."

Then, by experiments inside glass globes containing common air, he showed how the expansion of air by means of an air-pump will sufficiently chill it to

cause some of the aqueous vapor in it to condense as light cloud. He showed how the floating dirt in the air—"great chunks of matter"—favors the deposition of water as cloud, and how, as a rule, no cloud or mist will form in air which has been filtered five or six times through tightly-packed cotton wool, however much the air may be saturated with aqueous vapor. Mascart discovered that ozone in the air is a most powerful mist producer, and Aitken afterward discovered this independently. Sulphurous acid in the air forms nuclei which tend powerfully to favor the deposition of water as cloud, and it is the chief cause of London fogs. The sulphurous acid afterward oxidizes into sulphuric acid, and he had calculated that the amount of the latter acid formed in the London district in one day, originating from the sulphur in coal, might amount to not less than 200 tons. Sometimes some of this is blown away. Sulphurous acid is the chief cause of London fogs, but the soot and tar in the air make them darker. Smokeless stoves will not diminish the output of sulphurous acid from coal fires; the use of such stoves would make our fogs cleaner, but perhaps more frequent, more dense and more deadly. One remedy would be to re-enact the statute of Edward I., to make it punishable by death to burn coal in London. When the evils of the London atmosphere become too grievous to be borne, we shall probably substitute gas for coal as the standard London fuel.

The blackness of thunder clouds had appeared to him to be abnormal, so some few years ago he electrified a steam jet, and found that the opacity of the steam jet is increased when an electrical discharge is passed through it. When a water jet is so formed as to break into particles 2 ft. or 3 ft. from the nozzle, an electrified glass rod held near will cause the drops to disperse less than before, but if the rod be held very near indeed to the jet, it will cause them to disperse more than they did before. In the experiment of making a steam jet more opaque, there must be an actual discharge of electricity; a bit of burning touch-paper held near the jet causes a similar condensation. He thought the dust theory to be untenable as the cause of the condensation of the steam, and that it must be due to some disturbance in the air. When smoke is blown into the steam jet it causes no condensation, yet the presence of a red-hot platinum wire will sometimes act in the same way upon the jet as the smouldering touch-paper. He thought the problem presented to be one more easily solved by chemists than by himself. He suspected it to be due in some way to dissociated atoms of oxygen and nitrogen.

Mr. Bidwell thinks the origin of atmospheric electricity to be still obscure, although there are many different hypotheses upon the subject.

[Continued from SUPPLEMENT, No. 916, page 14646.]

POISONOUS PLANTS AND THEIR POISONS.

By J. GUARDIA, F.R.M.S.

SCROPHULARINEÆ.—*Digitalis purpurea*, the fox glove, one of the handsomest of British wild plants, is also one of the most powerfully poisonous. From its leaves is prepared quite a formidable array of drugs: "Digitaletin, digitaline, digitoleic, volatile and non-volatile digitalic acids, and inosit," but of these digitaline is the most important. Deaths are on record of persons dying through drinking decoctions of its leaves, but by far the greatest number of its victims have perished through taking overdoses of the powerful medicine prepared therefrom. Substances so toxic as this should never be taken or administered without competent medical advice, and as Professor Johnson so forcibly puts it, "it would be, indeed, about as wise to trust a child with a lighted taper in a magazine of gunpowder as a human life to the incautious wielder of a remedy so deadly." It is also believed that digitaline has an "accumulating power" over the action of the heart, and that doses so small that at the time they will produce no unpleasant effect, may, if taken repeatedly for some time, occasion sudden death.

The THYMELÆACEÆ constitute an order of generally acrid properties. We have in England *Daphne laureola* and *mezereum*. The berries of the spurge laurel and of mezereon contain a substance named coccognin; they are highly poisonous, a few, three or four, have produced serious illness, and a larger number, if eaten, would prove fatal. Their color, black in *laureola* and bright red in *mezereum*, makes them attractive to children, and therefore more dangerous. The bark of these and allied shrubs produces a bitter glucosid, daphnine, which renders them the most powerful of acrid poisonous plants. The mere outward application of the bark on the skin rapidly produces a deep, penetrating, and often ulcerating inflammation, while a strong decoction will completely destroy the mucous membrane lining the alimentary canal.

The EUPHORBIACEÆ, of which we have about sixteen species representing the genus Euphorbia, one Buxus and two Mercurialis in England, constitute a large order of some three thousand species. Many of these contain a milky juice, "latex," which is often highly toxic, though in others the poisonous principle may be dissipated by heat, and they then yield such edible substances as cassava meal and tapioca.

Euphorbia lathyris, etc.—The hardened milky juice of many spurges forms the substance known as euphorbium, which is a violent irritant. This species is often cultivated for the sake of its fruit, which is pickled and eaten as a substitute for capers, hence its name—caper spurge. Real capers are the flower-buds of (*Capparis spinosa*), a scrambling bush of the south of Europe, and belonging to the quite distinct order *Capparideæ*. These true capers are quite wholesome, but the fruit of the spurge is intensely acrid when fresh, and the pickling process it undergoes probably only partly lessens its poisonous action. All our spurges are more or less toxic, and they well deserve their German name—*Wolfsmilch*. Several cases of deaths caused by British species are on record, *E. peplis* and *E. helioscopia* being among them, and in all instances the alimentary canal was highly inflamed and corroded. *Euphorbia hibernica*, so the Rev. C. A. Johns informs us, "is extensively used by the peasants of Kerry for poisoning, or rather stupefying, fish. So powerful are its effects, that a small creel, or basket, filled with the bruised plant, suffices to poison the fish for several miles down a river."

Mercurialis perennis and *annua*.—The mercury contains a volatile alkaloid, mercurialine, which, at least chemically, somewhat resembles coniine. Cases have been mentioned of persons being poisoned through eating the dog's-mercury, but the annual mercury is far less powerful in its effects, and, indeed, its leaves are often boiled and eaten as a pot-herb.

The manchineel tree (*Hippomane mancinella*), a native of tropical South America and the West Indies, may be mentioned here, it being a *poison celebre*. The wonderful accounts of its power, for instance, that persons have died from merely sleeping beneath it, that a single drop of its juice falling upon the skin burns like fire, etc., should be subject to a considerable discount, as they are probably exaggerated.

The cassava (*Manihot utilissima*) contains prussic acid, and possibly another acrid principle of the nature of the one found in some spurges, and these render its juice highly poisonous. The roots of this plant, however, are rich in farinaceous matter, from which the cassava meal and tapioca are prepared. These roots, which weigh thirty to forty pounds, are grated; after washing, the poisonous juice is separated by pressure, and the residue is then made into thin cakes, and baked. Prussic acid and the acrid principle being volatile, the remaining poison is completely dissipated during the baking. Tapioca is a pure starch which settles in the troughs where the cassava meal is washed. It is granulated upon hot plates.

URTICEÆ.—*Urtica urens, pilulifera*, etc.—Although our nettles can scarcely be called poisonous plants, yet no one who has ever fallen into a bed of them, and there made their close acquaintance, will be surprised to see them mentioned here. As is well known, the leaves, etc., of the nettle are covered with numerous stiff hairs. These hairs have siliceous walls, as can be proved by heating a portion of the leaf red hot on a mica plate or platinum wire, and their tips are bent into sharp hooks. In case of careless contact, the hairs, by means of these points, enter the skin, and being very brittle they break off, and the sap, which is strongly caustic, enters the wound and produces inflammation. The sap of the hair or "sting" of the nettle contains a volatile acid of an acrid, pungent odor, similar to acetic acid, and it is called formic acid, from having first been found in ants. As yet formic acid has been discovered in only a few plants, viz., in the leaves, bark and wood of the *Coniferæ*, in the fruits of (*Sapindus saponaria*), (*Tamarindus Indica*), the leaves of *Urtica* and *Sempervivum tectorum;* but it exists, in all likelihood, in many other plants (Dr. Wittstein). The burning pain produced by the sting of the nettle is well known, but even that of our most virulent species, *U. pilulifera*, soon abates and disappears. Their effects, however, are not to be compared with those of some Indian species. M. Leschenault thus describes the result of touching (*Urtica crenulata*) in the botanic gardens at Calcutta: "One of the leaves slightly touched the first three fingers of my left hand; at the time I only perceived a slight pricking, to which I paid no attention, but the pain continued to increase, and in an hour it had become intolerable; it seemed as if some one was rubbing my fingers with a hot iron, though no swelling or inflammation could be seen. The pain rapidily spread along the arm as far as the armpit. I was then seized with frequent sneezing, with a copious running of the nose, as if I had caught a violent cold in the head; soon after I experienced a painful contraction of the back of the jaw. . . . I continued to suffer for two days, and the pain returned in full force whenever I put my hand into water. I did not finally lose it for nine days." There is another species of nettle in Timor, the effects of which are said by the natives to last for a year, or even to cause death.

I must not fail to mention the celebrated upas tree (*Antiaris toxicaria*), the juice of which is a violent poison, as it contains strychnine. Its effects, however, have been greatly exaggerated. "The tree is one of the largest in the forests of Java. Close to the ground the bark is, in old trees, more than an inch thick, and upon being wounded yields plentifully the milky juice from which the celebrated poison is prepared. The inhabitants do not like to approach it, as they dread the cutaneous eruption which it is known to produce when newly cut down. But except when the trunk is extensively wounded, or when it is felled, by which a large portion of the juice is disengaged, the effluvium of which, mixed with the atmosphere, affects the persons exposed to it with the symptoms above mentioned, the tree may be approached and ascended like the common trees of the forest." (Dr. Horsfield.)

CONIFEREÆ.—*Taxus baccata*.—Though the dangerous properties of the yew have sometimes been denied, it is now a well-known fact that its leaves and the kernels of the fruit are highly toxic, and have often proved fatal to human beings and to cattle. The leaves contain an alkaloid—taxin—which dries in the form of a white, loose, amorphous powder, very bitter to the taste and a violent narcotic-acrid poison. Several cases are known where children have died through eating the berries, and the leaves have often caused the death of women who had taken infusions of them under mistaken ideas. The juicy red cups of the berries are harmless, but the kernels, as already stated, are highly poisonous. The savin (*Juniperus sabina*) is also toxic, and the powder prepared from the dried tips of the branches greatly irritates the alimentary canal, sometimes to a fatal point.

AMARYLLIDEÆ.—To this order belong the narcissus, daffodil, snowdrop, etc., and as the beauty of their flowers has made them such general favorites, many readers may be surprised that every part of these plants, especially in *N. pseudonarcissus*, (*N. poeticus*), and *N. biflorus*, is strongly emetic, and their very odor, though pleasant, is deleterious, producing intense headache, stupefaction, and even vomiting, if indulged in to excess. Their active principle is particularly strong in the bulbs.

DIOSCOREÆ.—The yam-tribe has only one representative in England, the black bryony, *Tamus communis*. Like many others of its tribe, our species has powerful acrid properties, which render it dangerous. Death in its most painful form is the result of an overdose of the medicine prepared from its roots by quacks and others (Professor Johnson).

LILIACEÆ.—(*Scilla maritima*).—A squill of the Mediterranean region, and sometimes cultivated in gardens, has a large bulb, from which is prepared a yellowish-white powder—scillitin—which is a virulent narcotic-acrid poison. Even in small doses it often causes torpor, coma, sometimes death. Cats, rats, and mice are particularly sensitive to its effect. The bulb of our common bluebell or wild hyacinth, *S. nutans*, is also very acrid, and probably has a deleterious effect similar to, but by far less powerful than, that of the Mediterranean species.

Colchicum autumnale.—The whole plant of our meadow-saffron contains the alkaloid colchicine, and its seeds sabadillic acid, and these render the plant toxic to a high degree. Numerous cases of death through eating its bulbs or drinking solutions of its juice are known, and at least one case is recorded of a man who, having swallowed some of the seeds, was soon attacked with violent pain in the throat and vomiting, and death rapidly ensued. Here may be mentioned (*Veratrum album*), which grows in many places on the Continent, and (*Schœnocaulon officinale*) of Mexico. The root of the one and the seeds of the other contain both veratrine and sabadillic acid, which combine to make the respective parts of these plants virulently poisonous.

The AROIDEÆ are represented in Britain by the curious cuckoo-pint or wake robin, *Arum maculatum*, a rather common plant, six to ten inches high. The stalk, leaves, and fruit are intensely acrid, and if they are eaten, the tongue and throat become so swollen that death, preceded by convulsions, has often ensued. The corm also possesses these properties, and if it is crushed and rubbed on the skin, it will produce a burning sensation, and even raise blisters. Like in the case of the cassava, heat will dispel the poisonous properties of the root of the arum, and by soaking these in water, then baking and reducing them to powder, a very wholesome starch is produced, known as Portland sago. Our little wake-robin gives no idea of the size attained by some aroids in the tropics. Bates thus speaks of (*Caladium arborescens*) as found on an island in the River Amazons: "The woody stems of the plants near the bottom were eight to ten inches in diameter, and the trees were twelve to fifteen feet high; all growing together in such a manner that there was just room for a man to walk freely between them. There was a canoe in-shore, with a man and a woman; the man, who was hooting with all his might, told us in passing that his son was lost in the 'aningal' (arum grove). He had strayed whilst walking ashore, and the father had now been an hour waiting for him in vain." Whilst F. W. Burbridge tells us that (*Amorphophallus campanulatus*), which he saw growing near Singapore, "is of Titanic dimensions, producing a lurid spathe, nearly two feet in circumference, and exhaling the most fetid and repulsive of odors." Another exotic member of this group, from the West Indies, grows to a height of five to six feet, and its juice is so extremely acrid that when touched by the tongue it occasions excruciating pain, accompanied by an intense inflammation of the tongue which prevents speech. Hence it is called dumb-cane.

GRAMINEÆ.—The grass tribe gives us but one deleterious species, and this is the darnel, *Lolium temulentum*. The flower ground from its seed is gray, has an unpleasant smell, and when boiled in water it causes a strong effervescence, and produces a stupefying odor. When kneaded with water it makes a bad dough, which does not rise properly. The bread baked from it is black, and has a bitter, unpleasant taste. The darnel is a narcotic-acrid poison, and its effect generally resembles that of intoxication by alcohol. "The first intoxicating effect is usually succeeded by dizziness and loss of sight, often followed by delirium. In some cases paralysis and gangrene of the limbs have followed the continued use of bread containing darnel" (Professor Johnson). And one case is on record of a man who was killed by persisting to eat bread made from flour containing one part of darnel to five of wheat.

We have now passed in review, besides a few foreign species, the most important poisonous plants of our endemic Phanerogamic Flora. But we have many others which possess more or less acrid properties, or possibly contain other poisons, but in such small quantity that they have not proved dangerous to man. Among these we may mention the wood-sorrel, *Oxalis acetosella*; wall-pepper or biting stone-crop, *Sedum acre*; sundew, *Drosera rotundifolia*; elder, *Sambucus nigra*; leopard's-bane, *Doronicum pardalianches*; acrid lobelia, *L. urens*; hound's-tongue, *Cynoglossum officinale*; yellow toad-flax, *Linaria vulgaris*; box, *Buxus sempervirens*; sorrel, *Rumex acetosa*; fœtid iris, *I. fœtidissima*; flag, *I. pseudacorus*; herb Paris, *P. quadrifolia*, etc.

No list of poisonous plants would, however, be at all complete that did not, at least, mention those remarkable cryptogams, the FUNGI—mushrooms or toadstools—for while many species are highly nutritious, many more are virulent poisons. Their action is generally acrid or narcotic, but sometimes their poison is said to resemble arsenic in its effects, and in one case the symptoms were like those of Asiatic cholera. Mr. Worthington G. Smith, one of our leading fungologists and an enthusiastic fungus-eater, tells us he invariably tastes every toadstool new to him, and has notes to this effect on all the species he has selected: "In some species the effect is very peculiar, sometimes (as in *Agaricus mellens*) it causes a cold sensation at the back of the ears, and swelling of the throat; at others (as in *Marasmius caulicinalis*), the taste proves to be intensely bitter; some are so fiery (as in *Lactarius turpis, blennius* and *acris*) that the smallest piece placed upon the tongue resembles the contact of a *red-hot* poker." Their odor he also found to differ: "Many are very pleasant, like meal; a few are sweet; some resemble stinking fish (as *Agaricus cucumis*); one, mice, as (*A. incanus*); another, camphor; whilst *Marasmius fœtidus*, and *impudicus* are like putrid carrion; others are like burnt flannel, garlic, rotten beans, and almost every imaginable disagreeable thing." (W. G. Smith in *Science Gossip*.)

Unfortunately there is no "golden rule" for the discrimination of the edible and noxious species, and a long study, often of purely microscopical details, is required before this can be done with safety. The odor, taste, and general appearance are, however, the most reliable guides Nature has given us in these and

other toxic plants. And, roughly speaking, we might say that *edible* mushrooms generally have a white, creamy or buff color; the gills are white or pink, and the stem white or gray; their taste is mild or sweet, and their odor agreeable; their white juice does not readily change color when exposed to the air, and their flesh is firm. On the other hand, most fungi that are red, scarlet, green or black on the top, those having yellow, red or brownish gills, and a stem of similar color or perhaps spotted; all those that have an acrid or burning taste, and an unpleasant smell; and those that turn blue or red when broken; that freely secrete a milky fluid, feel slimy and generally flabby—should be avoided as probably *dangerous*. Among the most common of our poisonous species we find: *Agaricus vernus, Phalloides, mascarius, sinuatus, crustuliniformis, piperatus; Lactarius pyrogalus, acris, rufus; Russula emetica, Marasmia urens*, and *Phallus impudicus*.*

We have now thrown a rapid glance through one of the most interesting pages in the wondrous book of nature. In spite of our necessarily somewhat hasty review, we have found, even in the limited area of our British Flora, a formidable array of plants noxious to animal life in a high degree. These unexpected results naturally lead us to inquire: What is the cause of poisons in plants, and how were they produced? Only one logical answer can be given: They were evolved through the struggle for existence, which, selecting those variations *most useful* to the plant, gave the most poisonous individuals a better chance to live!

Poisonous plants do not form a single and isolated group; they are, as we have seen, scattered here and there among the different orders, nearly every order containing, in some part or other of the world, some poisonous species. We have, likewise, seen that all these plants do not produce the same poisons, although generally all species of an order, or at least of a genus, possess similar properties. We cannot have helped observing that we seldom find two or more poisons in different plants of the same nature or intensity, while, on the other hand, we can easily trace a perfect series where the toxic properties range from a slight acidity of the sap (as in *Rumex oxalis*, etc.) to a copious and highly virulent special secretion. These secretions, again, may be found either all over the plant, or they may be produced in particular, often very limited, organs, as in many seeds (notably the "ordeal beans" of *Physostigma*), in barks, roots, the "stings" of *Urtica*, etc. From this follows that while in some plants every part is toxic, in others some parts are not only harmless but indeed highly nutritious (*e. g.* the potato). And, finally, let me remark that few plants are equally noxious at all periods of their life, as many only reach their highest point of virulence at the time of flowering. I have laid so much stress on this *tendency to vary* because it is *this* that has enabled natural selection to preserve the most poisonous plants of any given group, and thus to give rise to more highly toxic varieties and species.

Plants form the natural food of animals, and are continually destroyed in incredible numbers by multitudes of snails, insects, birds and mammals. It is evident that any species possessing no defenses (or one the defenses of which had ceased to be adequate to new requirements) would soon be exterminated—as many doubtless have been. Mechanical defenses, such as thorns, spines and hairs, though forming a good protection against some of their foes, are soon overcome by others, and it is plain that no plant could be better protected than by having properties noxious, or at least distasteful, to most animals preying on it. Now, any animal coming to feed on a bed of growing plants, such as we often see in the spring, would naturally select for food those most agreeable to the taste, or, if all happened to be seedlings of a poisonous species, it would eat the least loathsome. In this way, the animal would unconsciously favor the most virulent plants, not alone by letting them grow on, but also by clearing the ground of species or individuals that would have competed for moisture, soil, air and light. They would then grow strong, perfect, and produce healthy seed inheriting their toxic but, for the plants, useful properties. We have only to allow sufficient time for this unconscious (*i. e.* natural) selection, of the most virulent from the most poisonous, in different places and by various animals, and in the course of time, may be of ages, we should find numerous plants, all producing poisons, but differing in nature and intensity in all degrees. And this is actually the case!

Whether some poisonous products (some of the alkaloids, for instance) have now come to be of other uses in the economy of the respective plants, we do not know. We cannot, however, doubt that the most of these properties, except perhaps when *very* slight, have been developed through the influence exerted on the vegetable world by the animal kingdom since they first came into close contact. The poisons of plants must therefore be regarded as purely defensive weapons, and the peculiar nauseous odor, the dark, lurid, ugly colors and generally repellent appearance of most poisonous plants warn all animals of their dangerous nature.—*Science-Gossip.*

SIAMESE FRUITS.†

THE fruits peculiar to the peninsulas and islands of Malay Land are so wholly unknown in England even by name, except to those familiar with the writings of the few naturalists who have visited the Archipelago, that some description of the Indo-Malayan (and therefore Siamese) fruits may not be without the interest of novelty.

If this article were to be taken as a description of the chief fruits of Siam, it might be thought that from this corner of Asia the banana and mango, so well known in India, were singularly absent. But I write now in the midst of a great fruit plantation just outside Bangkok, and here the long, drooping finger-leaves of the mango tree and the great broad leaves of the banana, now sadly ribboned by past storms, are only less prominent than the stately areca-palm which towers over all.

But we must confine our attention to the fruits that are now within my reach, and refrain from the temptation to dilate on favorite absentees.

Of the seven fruits in the group only three are quite peculiar to Malay Land; these shall be described first. The fourth and fifth are Asiatic fruits, but have a wide tropical range; and the last two are of American origin, long cultivated in Asia.

(1.) Number one shall be the "king of fruits," the famous durian, about which Wallace says that "to eat durians is a new sensation worth a voyage to the East to experience." Indeed, Wallace's description of the durian is so complete and so appreciative that I cannot do better than advise you to supplement my necessarily brief account of this marvelous fruit by reading what he says about it in Chapter V. of "The Malay Archipelago." So strong and sharp are the durian spines that it is almost impossible to lift the fruit off the ground if the stalk has been broken off. When the ripe fruit falls from the lofty tree on which it grows, it is certain to inflict serious injury on any unfortunate creature who may happen to be immediately below. The blow given by the huge fruit is itself very severe, and the spines tear the flesh terribly; so that "trees and fruits do not appear to be organized with exclusive reference to the use and convenience of man;" otherwise why doesn't the durian grow on a low tree like the jack-fruit?

Opinions of travelers are divided into two distinct classes as to the merits of the durian. The enthusiastic encomiums of Wallace will seem strangely contradicted by the strongly-expressed aversion of men who have traded and traveled but not lived in Durian-land. The fact is that the king of fruits has, unfortunately, an extremely disagreeable odor, "like onions in a state of putrefaction," which makes its presence indoors an intolerable nuisance, so that those who do not know the secret about durian eating never get further than reviling the odor. The only way to overcome the first repugnance is to eat durian out of doors at the foot of the tree from which it has just fallen, for even an hour's delay spoils the exquisite flavor—a flavor so truly "indescribable" that "a rich butter-like custard, highly flavored with almonds," "cream-cheese," "onion sauce," "brown sherry," are among the "incongruities" of which it reminds one.

The Siamese call this fruit the "too-reean," and as "reean" means also "to learn," there may be some humorous reference to the necessity of an education in durian eating; but the Siamese are so rarely humorous that this is probably a mere linguistic coincidence.

The botanists, or at least the few whose works I am able to consult, seem undecided as to the place *Durio zibethinus* shall occupy in the great families of plants, whether it shall be regarded as a member of the tribe Bombaceæ in the order Malvaceæ, or whether Bombaceæ shall be elevated to the rank of a separate order. But as very few of the ordinary text-books mention the durian at all, it is not much use trying to settle the matter at present.

(2.) Of the Malayan mangosteen no one says anything but praise. It has no unpleasant odor, is of conveniently small size and of most luscious flavor. The "Pride of the Malays" is a title accorded to it which bears evidence to the good taste of even rice-eating Malays. In size and shape it is like a small apple or orange, but in exterior coloring and interior arrangement far different. Its rind is of dark mahogany color, and is so hard and leathery that it requires a very strong hand and sharp knife to cut it. Oriental servants usually slit the rind midway all round before sending the fruit to table, then the upper half can be lifted off and the edible fruit exposed. The decussate pairs of thick, leathery sepals and the closely-appressed stigmas can be readily seen on looking at a good mangosteen.

When the upper half of the rind is taken off the fruit, a sight of beauty meets the eyes, and, after the first experience of the taste of this delicious fruit, makes the mouth water. A deeply-sectioned pulp of dazzling whiteness lies in its dark brown cup, inside the margin of which there is usually a layer of deep golden gamboge. The pulp is more deeply lobed exteriorly than in the orange, the number of lobes varying between five and eight. It is a favorite trick of Europeans in the East to ask new-comers to guess how many sections of white pulp there will be when the fruit is opened. As the number is indicated by the flattened stigmas outside, any one with a mere smattering of botanical knowledge has no hesitation in stating a number which is always correct, much to the amazement of the uninitiated. No words can do justice to the exquisite flavor of this rich glutinous pulp. The fruit is perfectly harmless, and any quantity can be consumed at tiffin with impunity. Europeans always bar fruit after mid-day, thinking it unsafe.

The gamboge of the mangosteen is found in other members of the same family in such abundance that this product gives the name to the whole order—Gulliferæ. The mangosteen, *Garcinia mangostana*, so named after the traveler, Dr. Garcin, does not yield enough of the pigment to make it worth extracting, but *Garcinia morella* is the source of the cake-gamboge or camboge of Siam, the best in the world. To obtain the pigment the leaves and young twigs of suitable trees are crushed, and the resinous gum collected in much the same way as it is now proposed to obtain gutta percha from *Isonandra dychopsis*. Gamboge is chiefly valuable commercially as a pigment, but it is also employed medicinally for its purgative properties. It is curious that the mangosteen also contains an astringent medicine in the tannin of the leathery-looking rind, which is used in cases of dysentery, and as a gargle in throat disorders. The tree on which the mangosteen grows has beautiful glossy leaves, like those of the citron tree, and is altogether so highly ornamental that it is cultivated in the Batavia gardens for its appearance as much as its fruit. Efforts to naturalize the mangosteen in India have hitherto failed, and there seems little hope of this trophy of the Moluccas ever becoming widely known.

(3.) The little-known rambutans, mentioned by Wallace in his remarkable list of the fruits found in Borneo, are small burr-like fruits. The litchi and lougan are delicious fruits of the same family (Sapindaceæ), well known in India, but I cannot ascertain that the rambutan is naturalized further west than the Malay Peninsula. The Siamese name of this little fruit is as repellent as its horny exterior; the syllable "ngau" most nearly represents the sound, but a European need never hope to master these unutterable nasals. When the rough coat is removed, the small round fruit looks like an egg whose albumen is stiffened but not made opaque in the stiffening; perhaps the semi-transparent white of raw onion laminæ most nearly resembles the rambutan in color and consistence. In the center of the pulp is one large stone which the Siamese scoop out at one end with a kind of tweezers, leaving the cylinder of edible fruit unbroken. The flavor is sweet and pleasant, and the abundant juice very refreshing.

(4.) The huge jack-fruit is so well known in India and so far inferior as a fruit to the others in the group that scant notice may suffice. The enormous size of the fruit is the result of the coalescence of many pistillate flowers—perianths, carpels and receptacles, all being absorbed and swollen out of recognition, and finally forming a mass weighing as much as sixty pounds. When one small tree is laden with three or four of these great yellow spine-covered masses, one is forced to marvel although one can't admire. The jack-fruit is not a thing of beauty, and its flavor, like that of "mashed potatoes," is far inferior to the flavor of the bread-fruit of the Oceanic Islands far east. It is curious that the bread-fruit (*Artocarpus incisa*) and the jack-fruit (*Artocarpus integrifolia*), both edible and highly nutritive, should belong to the same order (Artocarpaceæ) as the deadly upas tree of Java, whose resinous juice is a virulent poison.

Although the jack is rather a failure as a fruit, it is good enough as a vegetable, and makes capital fritters and puddings. The still more valuable bread-fruit may yet be transplanted to the West Indies—unfortunately the seeds become abortive by cultivation—and there grown, as Wallace suggests, for the Covent Garden market.

(5.) The shaddock, otherwise the pompelmousse or pommelo, is only an orange of larger bulk and less regular shape. Southeastern Asia was the ancestral home of all the oranges, and yet boasts of a greater variety of these beautiful, glossy-leaved, golden-fruited trees than any other part of the world. Here in this fruit-garden are orange trees of many kinds, from the pretty garden shrub, whose pinnate leaves are of that vivid green young Siamese dandies affect for their panungs, and whose lovely white flowers are provokingly frail, to great trees only slightly inferior in height to the graceful areca palm.

In color both of rind and pulp the shaddock resembles the lemon rather than the common orange; and its flavor is too sweet to be as pleasing to European taste as the refreshing acidity of the oranges of Southern Europe. With judicious grafting and cultivation much improvement might be effected, and the shaddock might yet become a right royal fruit worthy to be the durian's "queen."

(6.) Of the two American fruits least known in Europe, and therefore the most interesting in the present connection, is the papaw or *Carica papaya*, the chief member of its family, Papayaceæ. The malakaw, as the Siamese call it, is grown in almost every garden round Bangkok, and the very tropical appearance of the whole tree is sure to arrest the attention of the new-comer. Its straight palm-like stem is rarely more than twenty feet high; there are no branches, only the scars of fallen leaves. The long-stalked, much-dissected leaves remaining stand out singly from the upper part of the stem; under their shadow are clusters of waxy white flowers, or of large pear-like fruits clinging close round the stem. As the fruit hangs on the tree, the exterior markings of the cell divisions can be easily seen, but nothing prepares one for the wonder of the opened fruit. When fully ripe the green coat turns yellow and the fruit is as large as an unhusked cocoa-nut. Cut midway across with a sharp knife, a very remarkable and beautiful arrangement presents itself. Inside the soft rind is a circle, over an inch wide, of deep golden pulp, much the same in color and consistence as that of a good mango, and in the center is a pentagonal hollow big enough to hold an ordinary orange, and with its five sides completely covered with gray moist seeds, attached by a cord to the nourishing matrix of yellow pulp. One glance at such a fruit as this would at once dispel from the minds of young botanists all haziness as to the meaning of the "parietal placentæ" and "absorbed dissepiments" of their text books. Here the five cell walls have completely disappeared, and only the markings on the inside and outside of the rind are left to tell the tale. Sometimes only three or four cells are indicated, but five is the normal number, as the flowers are pentamerous. When the seed is examined it is found that the gray color is the result of a perfectly black seed being covered with a semi-transparent membraneous coat. The unripe malakaw makes a good vegetable; the ripe fruit is not unlike mango, with the same sickly sweetness. The natives here say that tough meat becomes tender if wrapped in the malakaw leaf. There is no question about the saponaceous quality of the leaves, and a cosmetic is made from the juice.

(7.) The pineapple is so well known in England, both as an import from the West Indies and as a home growth, that it is unnecessary to describe its peculiar botanical arrangement, about which all the text books say quite enough.

The pineapple, like many another plant of American origin, has probably been introduced into Malaysia by way of the Philippines, in the days when the Portuguese were the masters of the traffic between America and Malaysia and owners of many forts on island and mainland. The pineapple thrives so well in the southern part of the Malay Peninsula that a very important branch of trade has sprung up in Singapore in the preserving and canning of this delicious fruit. Europeans in the East, ever in dread of gastric disorders, are somewhat afraid of the pineapple, the hard white fibrous portions, and even the fibers of the juicy pulp, being a fertile source of trouble.

Not one of these seven fruits is at all good eating in its wild state. All have doubtless been under some sort of cultivation here or in their native soil for many centuries, and their present lusciousness is the result largely of this cultivation. In the matter of wild fruits, as of wild flowers, the tropics are far behind our own gloomy-skyed island in the West. There is nothing here to compare with the wild raspberries, strawber-

* For further information see "Mushrooms and Toadstools," by Worthington G. Smith (Allen & Co.), with two sheets containing altogether sixty excellent colored figures of edible and poisonous fungi.

† Hardwicke's Science-Gossip.

ries, nuts, hips and haws of English woods; as there is nothing to compare with the daisies and buttercups, primroses and anemones, daffodils and briar-roses. Magnificent flowers are sometimes met with, wonderful fruits are doubtless frequent; but for the widespread glory of English wild flowers and the abundant variety of English wild fruits the monotonous green of the tropics is, after all, a poor return. But let the master, Wallace, speak on this point also.

To help to make the durian and mangosteen known at least by name and brief description to the fruit-loving people of England, and to further widen the opportunities for bringing all good things within the reach of the appreciative, may be one small link in the lengthening, strengthening chain binding East and West together. K. GRINDROD.

Bangkok, Siam.

THE CONDITIONS DETERMINATIVE OF CHEMICAL CHANGE.*

By HENRY E. ARMSTRONG.

NOTWITHSTANDING the large amount of evidence now placed on record that substances commonly supposed to be capable of directly interacting do so only in the presence of at least one other substance, chemists do not appear to have arrived at any clear and consistent understanding of the conditions determinative of chemical change. As each fresh case is recorded, we continue to express surprise, overlooking the fact that Faraday, in his early "Experimental Researches in Electricity," clearly foresaw what the conditions were, and that but a slight extension of his generalizations is needed to frame a comprehensive theory. The subject is of such importance that it appears to me desirable to discuss the bearing of recent observations, especially as they to some extent necessitate the modification of views that I have expressed elsewhere, and in order to attract the attention of physicists, to whom we must now look for guidance in these matters.

Eight years ago, in the course of the discussion on Mr. H. B. Baker's communication on "Combustion in Dried Gases" (*Proc. Chem. Soc.*, 1885, 40), I defined chemical action as *reversed electrolysis;* in other words, in order that chemical action may take place, it is essential that the system operated on comprise an electrolyte. I then pointed out that as neither hydrogen nor oxygen was an electrolyte, a mixture of only these two gases should not be explosive; and, moreover, that as water was not an electrolyte, and it was scarcely probable that water and oxygen or hydrogen would form an electrolyte, it was difficult to understand how the presence of water pure and simple should be of influence in the case of a mixture of hydrogen and oxygen. This forecast has since been verified, the remarkable series of experiments carried out by V. Meyer in conjunction with Krause and Askenasy having clearly demonstrated that the formation of water from hydrogen and oxygen takes place at an irregular rate, and is, therefore, dependent on the presence of a something other than water—I imagine an acid impurity. But this is a consideration which has not yet received the proper attention, and it is, therefore, desirable to emphasize its importance by reference to other cases. Mr. Baker's recent preliminary note on the influence of moisture in promoting chemical action (*Proc. Chem. Soc.*, p. 229) affords several interesting examples: Thus, he states that neither does hydrogen chloride combine with ammonia nor is nitric oxide oxidized by oxygen if moisture be excluded. In the former case, the addition of water should suffice to determine the combination, as water and hydrogen chloride together form a "composite electrolyte" (*cf. Roy. Soc. Proc.*, 1886, No. 243, p. 268); as neither nitric oxide nor oxygen, however, forms a composite electrolyte with water, in this case water alone should not determine the occurrence of change; but, if by the introduction of a trace of "impurity" in addition to water the presence of a composite electrolyte were secured (however high its resistance, owing to the smallness of the amount of "impurity"), action would set in, and when once commenced would proceed at an increasing rate, as nitric acid would be formed and the resistance of the electrolyte would consequently diminish. On this account it will be a task of exceeding difficulty to experimentally demonstrate that nitric oxide and oxygen are inactive in presence of water alone; but there can be no doubt that such must eventually be admitted to be the case, provided always that it is permissible to extrapolate Kohlrausch's observations and to conclude from them that *pure* water is a dielectric. The gradual increase in the rate of change here contemplated corresponds to the period of induction observed by Bunsen and Roscoe in their observations on the interaction of chlorine and hydrogen; the statement recently made by Bodenstein and V. Meyer (*Berichte*, 1893, 1146) that a mixture of chlorine and hydrogen behaves irregularly on exposure to light is a valuable confirmation of Pringsheim's observations, and there is now no room for doubt that *pure* chlorine and hydrogen would be incapable of interacting. That no such irregularity is observed on heating iodine with hydrogen is not surprising, as hydrogen iodide would be formed from the very outset and the electrolyte present would exert a minimum resistance almost at once. There is, however, a significant difference in the behavior of the two mixtures, as hydrogen chloride should behave as hydrogen iodide, so that the problem is but incompletely solved. It may be that the one mixture was more nearly pure than the other, or it may be that the formation of hydrogen chloride from hydrogen and chlorine, under the influence of light, is dependent on the presence of some particular substance, together with water, and does not take place under the influence of any substance capable of forming a composite electrolyte with water; probably, however, the difference observed is chiefly due to the fact that only one of the actions is reversible under the conditions prevailing in the experiments.

Lastly attention may be directed to the formation of sulphuric oxide from sulphurous oxide and oxygen, which is readily effected in presence of a catalyst, such as finely divided platinum; it cannot be supposed that the mere presence of platinum would condition the occurrence of change, and doubtless moisture is also necessary, the platinum or other catalyst but serving to promote the oxidation of the sulphurous oxide at a temperature considerably below that at which sulphuric oxide decomposes when heated. The action of surfaces generally may well be of this character, and the converse influence they so frequently exercise is probably an effect of the same order.

I have elsewhere raised the question whether there may not be a difference between actions taking place under the influence of low and of high electromotive forces—whether water *per se* may not be an electrolyte toward high, though not toward low, forces in the case of high temperature changes, or those brought about under the influence of the electric spark, for example. More attentive consideration of the subject has led me to think that this is not the case, and that we must treat high temperature changes such as occur and are involved in gaseous explosions in the same way as those occurring under ordinary conditions and at low temperatures. From this point of view Mr. Baker's statement that ammonia and hydrogen chloride do not combine is of extreme importance; the formation of ammonium chloride from these two compounds apparently involves no interchange, but a mere combination of two substances each endowed with considerable "residual affinity," and there is no reason why a distinction should be drawn between such a case and that afforded by say *atoms of hydrogen and oxygen*, the difference being, it would seem, one of degree only; in fact, I am no longer inclined to believe that atoms are capable of directly uniting. In all cases at least one function of the (composite) electrolyte would appear to be that of providing the necesary "mechanism" whereby the degradation or discharge of the energy is effected. If this argument be sound, its logical extension involves the conclusion that *pure* gases should be dielectrics, *i. e.*, that the passage of an electric discharge through a gas like that of an explosive wave through say a mixture of hydrogen and oxygen can only take place if an electrolyte be present. Hitherto but little attention has been paid to the electric discharge in gases which have been highly purified. The peculiar behavior of Tesla tubes referred to by Mr. Crookes in the discussion on Mr. Shenstone's paper on the formation of ozone is, perhaps, explicable from this point of view—it may be that the atmosphere within the tube does not become conducting until sufficient moisture and "impurity" have been projected from its sides. It is conceivable that a similar explanation may hold good in the case of Professor Schuster's observation, that it is possible to urge a current of low electromotive force across a gas subjected to a high electromotive force in itself insufficient to cause a discharge in the gas; the atomic dissociation hypothesis put forward in explanation of the phenomenon does not appear to me to be sufficient.

Finally, the question arises, Can no line be drawn? are no two pure substances capable of combining or interacting? For example, water and sulphuric anhydride. There is little to guide us here, but it seems not unlikely that water has special properties which enable it to act directly: moreover—perhaps because—in such cases composite electrolytes would result. Ammonium chloride, so long as it remains solid, is clearly a compound of a different order, and it may well be that compounds of this type are in no case directly obtainable from their constituents, because, under the conditions under which they are formed, they cannot behave as electrolytes.

Apparently, in all cases in which the molecular aggregates are formed—as in the case of solutions—we are dealing with dissociable and dissociating systems, and it is not improbable that we may ultimately find an explanation of the mechanism of such changes in this fact.

At present there is no information forthcoming whether simple electrolytes, such as fused silver chloride, for example, will condition chemical change in the way that water does—whether, for instance, silver chloride will condition the formation of hydrogen chloride from chlorine and hydrogen, so that a gas battery might be constructed of these three substances.

* Read before the Chemical Society, London.—*Chem. News.*

THE FORMATION OF OZONE.*

By W. A. SHENSTONE and MARTIN PRIEST.

THE authors have submitted a known volume of oxygen confined in an ozone generator of the Brodie pattern to the influence of discharges produced by varying differences of potential, and have determined the amount of ozone produced by observing the change in volume by means of a mercury manometer. A full description is given of the contact breaker used, of the means adopted to measure the differences of potential to prevent the ozone coming into contact with the mercury, etc.; in some of the experiments the discharge from an induction coil, in others that from an influence machine, was used. The following conclusions are drawn:

1. It is possible to obtain very fairly concordant results.

2. Provided that the path of the discharge be not too short at any point in the generator, the maximum proportion of ozone that can be produced at a given temperature and pressure is nearly independent of the difference of potential employed, provided that this be between the limits of 33 and 60 C.G.S. (electrostatic) units.

3. If the path of the discharge be very short at any point in the generator, the maximum proportion of ozone that can be obtained has an inverse relation to the differences of potential employed.

4. The rapidity with which oxygen is converted into ozone in a given ozone generator, and under given conditions of temperature and pressure, is greater when great than when small differences of potential are employed, or, in other words, a given percentage of ozone can be obtained more quickly by employing a high difference of potential than by means of a lower one.

5. The maximum proportion of ozone that is obtained in a given generator, at given temperature and pressure, is less when the number of discharges in unit of time is very great than when it is more moderate.

6. The highest proportions of ozone can be obtained (at given temperature and pressure, and if a given difference of potential be employed) by using a generator made of very thin glass and in which the inner tube fits into the outer tube rather closely, but such a generator acts very slowly if the mingling of its contents depends upon diffusion.

7. A greater proportion of oxygen can be converted into ozone in a given generator by means of a given difference of potential, the gas being maintained at a given temperature and pressure, by the action of an induction coil than by means of a "Wimshurst" or "Voss" machine.

The authors conclude from their results that the silent discharge acts by decomposing oxygen molecules into their atoms, which subsequently recombine to a greater or less extent (according to the temperature and pressure) to form the triatomic molecules of ozone; and that ozone is not formed by the direct action of the discharge.

DISCUSSION.

Professor McLeod referred to the heating effect of the discharge, and asked whether it had been noticed that a rise of temperature took place in the inner vessel of the generator which might account for the decomposition. He drew attention to the possibility of producing ozone in considerable quantity by subjecting oxygen under pressure to the influence of the discharge in a tube, one end of which was at a low temperature; unfortunately, the tendency of ozone to explode when in the liquid condition appeared to be a barrier to the successful application of this method.

Professor Ramsay commented on the fact that the authors had paid attention only to the influence of difference of potential, and had not taken into account what was probably of more importance, viz., the quantity of electricity in the discharge.

Mr. Crookes concurred in Professor Ramsay's criticism, and said that perhaps the difference observed in the case of the coil and influence machine might be ascribable to this, as the coil would afford a larger quantity of electricity; and that a rapid discharge would also afford a smaller quantity of electricity than a slow one. Locally, the temperature might be very high in such tubes. He then referred to the difficulty he had frequently met with in causing a discharge to pass in "Tesla" tubes. A tube through which no discharge would pass during several minutes would suddenly become luminous, but only when charged dangerously near to the breaking point.

Mr. G. N. Huntley asked whether Mr. Shenstone intended to study the effect of temperature on the yield of ozone; as it was a substance in the formation of which heat was absorbed, its stability should reach a maximum at a temperature fixed by its physical constants, and either above or below this temperature the yield of ozone should fall off. In connection with this, the production of ozone at 1,200° to 1,300° C., observed by Troost and Hautefeuille, required confirmation.

The president regretted that no electricians were present to discuss the arrangements adopted by the authors. Professor J. J. Thomson, he knew, held the view that the electric discharge in gases was of the nature of chemical action. Personally he was not satisfied with the evidence adduced by Cundall and Shenstone that only oxygen was concerned in the production of ozone. He was of opinion that it would eventually have to be admitted that the formation of ozone was the outcome of an electrolytic change, in which probably conducting moisture was concerned, somewhat as expressed by the symbols—

$$\begin{array}{ll} O_2 & OH_2 \\ O_2' & OH_2' \end{array} \; O_2 \begin{array}{l} \leftarrow O_2 \quad H_2O \\ \rightarrow O_2' \quad H_2O \end{array}$$

Mr. Shenstone, in reply, said that the electricity does not flow directly from the induction coil, or machine, into the ozone generator. It acts inductively, the ozone generator being a sort of condenser with a compound dielectric consisting of two layers of glass with a layer of oxygen between them. The discharge inside the ozone generator depends on a surface electrification set up on the glass. The "quantity" of electricity which passes through the oxygen in a given ozone generator at each discharge depends on the difference of potential thus set up, and this in its turn depends on the difference of potential of the inducing charge at the two electrodes of the generator. Therefore, when the difference of potential of the inducing charge is increased, the quantity of electricity which takes part in a discharge is increased, and *vice versa*, and we are, in fact, studying the effect of different "quantities" of electricity on the gas, and we know when we increase or decrease the quantity.

With regard to the suggestion that the greater "quantity" of the current of a coil may explain some of the phenomena, it would seem that this is not likely to influence the inductive effect of a charge at a given difference of potential. It would simply make it possible to bring up the discharge to the desired difference of potential somewhat more quickly by means of a coil than by means of a machine.

They had not observed any extra heating of the acid in the inner tube of the generator, but rather the contrary. Referring to Mr. Crookes' remarks, he said that they had sometimes observed that the production of ozone did not set in until after some time.

* From a paper recently read before the Chemical Society, London.—*Chemical News.*

DULCIN.

THE chemical nature of this substance—which has been introduced under this name, and that of "sucrol," as a substitute for saccharin—has already been described in "The Month" (see *ante*, p. 443), and the results of physiological experiments with it were given at page 888. In a paper, read by Thoms at a recent meeting of the Pharmaceutical Society of Berlin, dulcin is described as forming colorless needles melting at 173°–174°, soluble in 800 parts of cold water or 50 parts of boiling water, and in 25 parts alcohol of 90 per cent. When pure it dissolves in cold sulphuric acid without coloration. On the same occasion Dr. Stahl gave the results of his experiments on the administration of dulcin to animals by the mouth and by subcutaneous injection. They showed that considerable doses do not produce injurious effects even when long continued. It is only with very large doses, in excess of practical requirements, that some temporary inconvenience is experienced. These results are in general accord with those obtained by Kossel and Ewald (*ante*, p. 888). It has also been found that dulcin is agreeable to patients, and does not create the dislike some-

times caused by saccharin when its use is long continued. In chemical constitution dulcin or paraphenetol carbamide is closely related to urea, one of the amidogen groups being replaced by a phenetidine residue, as shown by the following formulæ:

$$CO<{NH_2 \atop NH_2} \qquad CO<{NHC_6H_4OC_2H_5 \atop NH_2}$$

This compound was first obtained by the reaction of paraphenetidine hydrochloride with potassium cyanate, but it has since been obtained by the reaction of paraphenetidine—the ethyl ether of amidophenol—with carbon oxychloride and subsequent treatment of the intermediate chlorinated product with ammonia:

$$\left.\begin{matrix} 2C_6H_4<{OC_2H_5 \atop NH_2} \\ \\ COCl_2 \end{matrix}\right\} = \left\{\begin{matrix} C_6H_4<{OC_2H_5 \atop NH_2.HCl} \\ \\ CO<{NHC_6H_4OC_2H_5 \atop Cl} \end{matrix}\right.$$

$$\left.\begin{matrix} CO<{NHC_6H_4OC_2H_5 \atop Cl} \\ NH_3 \end{matrix}\right\} = \left\{\begin{matrix} CO<{NHC_6H_4OC_2H_5 \atop NH_2} \\ HCl \end{matrix}\right.$$

Thoms endeavored to prepare paraphenetol carbamide on the assumption that paraphenetidine would react with aniline in the same manner that urea reacts with aniline to form monophenyl urea:

$$\left.\begin{matrix} C_6H_5NH_2 \\ CO(NH_2)_2 \end{matrix}\right\} = \left\{\begin{matrix} CO<{NHC_6H_5 \atop NH_2} \\ NH_3 \end{matrix}\right.$$

He found, however, that the simultaneous formation of diparaphenetol carbamide could not be prevented.

$$CO<{NHC_6H_4.OC_2H_5 \atop NHC_6H_4.OC_2H_5}$$

This substance has no sweet taste, but by heating with an equivalent quantity of urea for several hours it can be converted into the sweet mono compound, an interchange of an amidogen group against a phenetidine residue taking place as shown below:

$$\left.\begin{matrix} CO<{NHC_6H_4.OC_2H_5 \atop NHC_6H_4.OC_2H_5} \\ CO<{NH_2 \atop NH_2} \end{matrix}\right\} = 2CO<{NHC_6H_4OC_2H_5 \atop NH_2}$$

—*Pharm. Centralh.*, 34, 280.

THE FLAMES OF SOME METALS.

Denys Cochin.—The compounds of the alkaline and alkaline-earthy metals, when volatilized in flames, yielded the first known spectra. These spectra in the visible portion are not identical with those obtained in making use of electricity as the source of heat. It seemed to me that it was interesting to examine how they terminated on the side of the most refrangible radiations in a region where we have a great number of photographs of electric spectra, but no flame spectra. I have succeeded in photographing the spectra of colored flames by the aid of a spectroscope of two quartz prisms of inverse rotations, with lenses of quartz and spar, according to M. Cornu's arrangement (*Journ. de Phys.*, vol. viii. (1879), p. 185). The frame of the dark chamber, which serves as an eye-piece, is slanting as in most spectrographs, and it is provided with a cylindrical bottom upon which steel springs apply exactly a flexible plate (Eastman's film). The sensitive preparation is then quite entire in its focal surface, which is a cylinder with a base nearly hyperbolic. The bottom of the frame has been brought to this form by approximations. The time for exposure is very long, half an hour to an hour. It is shorter if we use the flame of hydrogen as a source of heat. The results are approximately the same in each case. We always obtain the bands of the vapor of water $\lambda = 309$, etc., and we have never been able to obtain the metallic rays situate below at least without further prolonging the experiment. The rays are identified by comparison with those of an electric spectrum produced by means of the sparks of a Leyden jar, striking between the poles of cadmium, aluminum, etc., for about a minute. They are prevented from covering all the height of the flame spectrum by means of a small perforated screen placed on the slit, which limits the spectrum for comparison to a small height. The following results were obtained:

ALKALINE METALS.

Lithium.—λ: 413.

Sodium.—Double ray λ: 330·3 and 330·2, mentioned by MM. Kayser and Runge as obtained with the electric arc.

Potassium.—Rays λ: 404 and 344·4.

Rubidium.—Visible ray λ: 420, and besides, by employing the flame of hydrogen, two twin rays distinguished by Kayser and Runge as λ: $359\cdot\frac{1}{10}\cdot7$ and $335\cdot\frac{1}{10}\cdot8$.

Cæsium.—Besides the visible blue rays λ: 459·7·450, we obtain the invisible rays λ: 388, λ: 361·3 and λ: 347·75.

ALKALINE EARTHY METALS.

Calcium.—Visible ray λ: 422·6. The exposure was prolonged with the flame of hydrogen for seventy-five minutes without obtaining the image of any invisible calcium ray, not even of the ray HH'. Nevertheless, the bands of watery vapor, λ: 309, and three bands beyond them, likewise due to vapor of water, have been photographed.

Strontium.—Visible ray λ: 460·7.

Barium.—Visible ray λ: 487. Ultra-violet rays have not been obtained for any of these three metals.

Thallium.—Two invisible rays, situate respectively to the left of the rays 10 and 9 of cadmium at λ: 353 and 378. The existence of these three rays in the flame spectrum approximates thallium to the alkaline metals.

MANUFACTURE OF PER-SALTS OF IRON.

By E. HERMITE and A. DUBOSC, Paris.

WHEN a solution of ferrous sulphate, to which a weak solution of the proto-chloride of iron, sodium, potassium, calcium, vanadium, or more especially magnesium has been added, is electrolyzed, a basic sulphate of the peroxide is formed according to the equation:

$$2(FeOSO_3 7H_2O) + O = Fe_2O_3 2SO_3 + 14H_2O$$

and the addition of an equivalent of sulphuric acid either before or after electrolysis causes the formation of the trisulphate of peroxide of iron, which is a most energetic agent for coagulating blood, and can be used in slaughter houses for the preparation of dried blood manure. By causing the sulphate of iron solution to circulate through apparatus arranged to maintain a maximum proportion of the salt in solution, a completely saturated solution of the sulphate of the peroxide can be obtained, and by varying the current density and its duration, a greater or less quantity of this body may be formed, constituting the various dyeing mordants known as rust, sulpho-nitrate, and persulphate of iron. A convenient form of apparatus for conducting the process consists of a tank of enameled iron with an outlet at the bottom for running off the contents when required, a perforated pipe in the lower part of the tank for supplying the solution to be acted on, and an overflow outlet at the upper part. The electrodes are plates of iron alternating with platinum sheets.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
361 Broadway, New York, N. Y.

TABLE OF CONTENTS.